

Declaration of Jules White, Ph.D.

U.S. Patent No. 12,353,917

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

WEALTH, INC.

Petitioner

v.

VANILLA TECHNOLOGIES, INC.

Patent Owner

Case PGR2026-_____

U.S. Patent No. 12,353,917

Title: EVENT-BASED RESOURCE ALLOCATION SYSTEM

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I. Introduction

I, Jules White, a resident of Nashville, TN over 18 years of age, hereby declare as follows.

1. I have personal knowledge of all of the matters about which I testify in this declaration.

2. On behalf of Wealth, Inc. (“Wealth.com”), I was retained to provide my technical opinions and about Claims 1-20 of U.S. Patent No. 12,353,917 (“the ’917 Patent”). I refer to those claims as the “challenged claims.” **Appendix A** reproduces the full text of the challenged claims.

3. I am being compensated for my work in this proceeding at my usual consulting rate of \$600.00 / hour, and being reimbursed for expenses incurred in the course of my work. My compensation is not contingent in any way on my opinions or on the outcome of this matter.

II. Bases for Opinions

4. I considered and analyzed the documents listed below in **Section III** in light of the specialized knowledge that I obtained via my education, training, research, and experience, summarized in **Section IV** and described in detail in **Appendix B**, my CV. My analysis of those documents, combined with the specialized knowledge that I have obtained through my education, training, research, and experience, form the bases for my opinions and testimony in this declaration.

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III. Materials Considered

5. In reaching my opinions in this matter, I have considered and analyzed the following documents:

Exhibit #	Description	Cited as . . .
1001	U.S. Patent No. 12,353,917.	'917 Patent
1002	U.S. Provisional Patent App. No. 63/603,895.	Provisional App. No. 63/603,895
1003	File History of U.S. Patent No. 12,353,917.	'917 Patent File History
1005	Int'l Patent App. Pub. No. WO2020/028252 A2 to Racanelli et al.	<i>Racanelli</i>
1006	U.S. Patent No. 7,031,935 to Chhabra et al.	<i>Chhabra</i>
1007	U.S. Patent App. Pub. No. 2015/0286630 to Bateman et al.	<i>Bateman</i>
1008	Michael Curtotti and Eric McCreath, <i>Corpus Based Classification of Text in Australian Contracts</i> , PROCEEDINGS OF AUSTRALASIAN LANGUAGE TECHNOLOGY ASSOCIATION WORKSHOP, 18-26 (2010).	<i>Curtotti</i>
1009	U.S. Patent App. Pub. No. 2017/0076381 to Dintenfass et al.	<i>Dintenfass</i>
1010	U.S. Patent App. Pub. No. 2025/0245763 to McMillen et al.	<i>McMillen</i>
1011	Alice Saebom Kwak et al., <i>Validity Assessment of Legal Will Statements as Natural Language Inference</i> , FINDINGS OF THE ASSOCIATION FOR COMPUTATIONAL LINGUISTICS, EMNLP 2022, 6047-6056 (Dec. 7-11, 2022).	<i>Kwak</i>
1012	Wayne Xin Zhao et al., <i>A Survey of Large Language Models</i> , arXiv:2303.18223v13 (Nov. 24, 2023).	<i>Zhao</i>

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Exhibit #	Description	Cited as . . .
1013	Georgios Fatouros et al., <i>Transforming Sentiment Analysis in the Financial Domain with ChatGPT</i> , 14 MACHINE LEARNING WITH APPLICATIONS 100508 (Nov. 4, 2023).	<i>Fatouros</i>
1014	Internet Archive Record of Krystal Hu, ChatGPT Sets Record for Fastest Growing User Base - Analyst Note, REUTERS (Feb. 2, 2023), https://web.archive.org/web/20230202011533/https://www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01/(captured Feb. 2, 2023) .	<i>Hu</i>
1015	Paula Maddigan & Teo Susnjak, <i>Chat2VIS: Generating Data Visualizations via Natural Language Using ChatGPT, Codex and GPT-3 Large Language Models</i> , 11 IEEE ACCESS 45181 (May 12, 2023).	<i>Maddigan</i>
1016	Yiheng Liu et al., <i>Summary of ChatGPT-Related Research and Perspective Towards the Future of Large Language Models</i> , 1 META-RADIOLOGY 100017 (Aug. 18, 2023).	<i>Liu</i>
1017	David L. Morgan, <i>Exploring the Use of Artificial Intelligence for Qualitative Data Analysis: The Case of ChatGPT</i> , 22 INT’L J. QUALITATIVE METHODS 1 (Oct. 2023).	<i>Morgan</i>
1018	Jules White et al., <i>A Prompt Pattern Catalog to Enhance Prompt Engineering with ChatGPT</i> , arXiv:2302.11382 (Feb. 21, 2023).	<i>White</i>

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Exhibit #	Description	Cited as . . .
1019	Internet Archive Record of Sawdah Bhaimiya, ChatGPT may be the fastest-growing consumer app in internet history, reaching 100 million users in just over 2 months, UBS report says, BUSINESS INSIDER (Feb. 2, 2023), https://web.archive.org/web/20230203044225/https://www.businessinsider.com/chatgpt-may-be-fastest-growing-app-in-history-ubs-study-2023-2 (captured Feb. 3, 2023).	<i>Bhaimiya</i>
1020	Alec Radford et al., <i>Learning Transferable Visual Models From Natural Language Supervision</i> , arXiv:2103.00020 (Feb. 26, 2021).	<i>Radford</i>
1021	Jean-Baptiste Alayrac et al., <i>Flamingo: a Visual Language Model for Few-Shot Learning</i> , arXiv:2204.14198v2 (Nov. 15, 2022).	<i>Alayrac</i>
1022	Internet Archive Record of Kyle Wiggers, OpenAI releases GPT-4, a multimodal AI that it claims is state-of-the-art, TECHCRUNCH (Mar. 14, 2023) https://web.archive.org/web/20250817160037/https://techcrunch.com/2023/03/14/openai-releases-gpt-4-ai-that-it-claims-is-state-of-the-art/ (captured Aug. 17, 2025).	<i>Wiggers</i>
1023	Danny Driess et al., <i>PaLM-E: An Embodied Multimodal Language Model</i> , arXiv:2303.03378 (Mar. 6, 2023).	<i>Driess</i>
1024	Internet Archive Record of American Heritage Dictionary of the English Language, definition of “between,” https://web.archive.org/web/20230930082124/ahdictionary.com/word/search.html?q=between (captured Sept. 30, 2023).	<i>American Heritage Dictionary</i>

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Exhibit #	Description	Cited as . . .
1025	Internet Archive Record of Cambridge Dictionary, definition of “between,” https://web.archive.org/web/20220322024512/https://dictionary.cambridge.org/dictionary/english/between (captured Mar. 22, 2022).	<i>Cambridge Dictionary</i>

6. In this declaration, I cite U.S. patents (*e.g.*, Ex. 1001 [’917 Patent]) by column and line. I cite patent application publications and other documents numbered by paragraph according to their paragraph number. Unless otherwise noted, all other citations in this declaration use the page numbers added to the exhibits by Wealth.com’s counsel.

IV. Qualifications

7. I have over 20 years of experience in computer science and computer engineering. I received a Bachelor’s degree in Computer Science from Brown University, and a Master of Science and Ph.D. in Computer Science from Vanderbilt University. I am currently a Professor in the Department of Computer Science at Vanderbilt University, Senior Advisor to the Chancellor on Generative AI in Enterprise and Education, and Director of the Amplify Generative AI Innovation Center. I was also previously an Assistant Professor in Computer Engineering at Virginia Tech.

8. I have held a variety of positions within industry and research affiliations with federally-supported research labs. Proceeding in reverse

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chronological order: From 2014-2020, I was President of Ziiio, Inc, a company that I co-founded. From 2012-2015, I was Chief Technology Officer of Optio Labs, Inc., a company that I co-founded. From 2012-2016, I was the Chief Scientist of Cloudpoint Labs, a company that I co-founded. From 2011-2012, I was a Visiting Research Scientist at the Carnegie Mellon Software Engineering Institute, a federally-funded research and development center. From 2001-2002, I worked as a software engineer at IBM.

9. I have published over 180 papers on topics ranging from mobile computing to cyber-security to cloud computing. According to Google Scholar, there are 12,700 citations to these papers. In addition to publishing on a variety of research topics, I have received several important distinctions. I received a National Science Foundation (NSF) CAREER Award, which is one of the NSF's "most prestigious awards in support of early-career faculty who have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization." I have also received several Best Paper Awards for research work in domains ranging from Software Product-lines to Civil Engineering to Computer Vision.

10. As a faculty member, I run the Mobile Application computinG, optimization, and secUrity Methods (MAGNUM) Group at Vanderbilt University. As a Principal Investigator or Co-Principal Investigator, I have received over

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\$17,000,000 in grant support, both from federal entities, such as the National Science Foundation (NSF), Defense Advanced Research Projects Agency (DARPA), Air Force Research Labs (AFRL), and Office of Naval Research (ONR), and private entities, such as Varian Medical Systems and NOAH Basketball. My research focuses on securing, optimizing, and leveraging data from mobile cyber-physical systems. My mobile cyber-physical systems research spans four key focus areas: (1) mobile, cloud, and CPS security and data collection, (2) high-precision mobile understanding of the world through indoor positioning and augmented reality, (3) CPS, mobile device and cloud infrastructure power and configuration optimization, and (4) applications of mobile cyber-physical systems in multi-disciplinary domains, including manufacturing, energy-optimized cloud computing, smart grid systems, healthcare/manufacturing security, next-generation construction technologies, citizen science, and augmented reality.

11. My research work has been transitioned to industry where it has both won patent protection and led to venture-backed startup companies. My work on securing mobile devices was licensed into Optio Labs, a company that I co-founded. Optio Labs received over \$10,000,000 in venture capital backing. My work on mobile augmented reality was licensed into PAR Works / Cloudpoint Labs, a company that I co-founded. The company received \$1,000,000 in venture backing

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and won awards, such as being an Innovation Award Honoree at CES and a finalist for Technical Achievement Award at SXSW. I am an inventor on multiple patents.

12. My research focuses on AI and AI Agents. My online courses, which focus on Generative AI, have over 1,000,000 people enrolled from over 1,000 organizations. My work on AI has been covered in the Wall Street Journal, The Guardian, CNN, Fortune, and other media outlets. In addition, I have authored highly cited papers on AI, such as my paper “A Prompt Pattern Catalog to Enhance Prompt Engineering with ChatGPT,” which has over 2,600 citations since 2023. I lead the Amplify Generative AI Innovation Center, which is tasked by the Provost and Chancellor with applying AI and AI Agents to solve business problems in university operations across domains from finance to resource allocation to planning.

13. In addition to the summary I provide in this declaration, I describe my education, training, research, and experience in greater detail in my CV, attached as **Appendix B.**

V. Legal Standards

14. Counsel for Wealth.com have explained the relevant legal standards to me. I describe my understanding of those legal standards below. I have used my understanding of those legal standards in reaching my opinions in this matter.

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15. I understand that Wealth.com has the burden of proving by a preponderance of the evidence that the challenged claims are unpatentable.

A. Obviousness

16. I understand that a patent claim is unpatentable if the claimed subject matter as a whole would have been obvious to a person of ordinary skill in the art at the time of the invention. I understand that the '917 Patent purports to claim the benefit of the priority of a provisional application filed on November 29, 2023. (Ex. 1001 ['917 Patent] at Cover; Ex. 1002 [Provisional App. No. 63/603,895].) For purposes of my analysis in this declaration and because I know of no indication from the patent owner or others to the contrary, I have applied a date of November 29, 2023 as the date of invention in my obviousness analysis and opinions, although in many cases the same analysis and opinions would hold true even at an earlier time than November 29, 2023.

17. I understand that the following factors are considered in assessing whether a patent claim is obvious: (1) the scope and content of the prior art; (2) differences between the prior art and the claims at issue; (3) the level of ordinary skill in the art at the time the invention of the asserted patent was made; and (4) objective evidence of nonobviousness, also known as “secondary considerations.”

18. I understand that only analogous art should be considered in analyzing whether a patent claim is obvious. I understand that a prior art reference qualifies

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as analogous art when (1) the reference belongs to the same field of endeavor as the patent at issue; or (2) the reference is reasonably pertinent to a problem that the inventors of the patent at issue sought to address.

19. I understand that obviousness can be established by combining or modifying the teachings of the prior art to achieve the claimed invention. I understand that, where there is a reason to modify or combine the prior art to achieve the claimed invention, a person of ordinary skill in the art must have also had a reasonable expectation of success for modifying or combining the prior art.

20. I understand that the reason to combine or modify prior art references can come from a variety of sources, not just the prior art itself or the specific problem the patentee was trying to solve. I understand that the references themselves need not provide a specific hint or suggestion of combination or modification needed to arrive at the claimed invention. The analysis may include recourse to logic, judgment, and common sense available to a person of ordinary skill in the art, which does not necessarily require explanation in any reference.

21. I understand that there are several rationales that may support a conclusion of obviousness. Examples include:

- Combining prior art elements according to known methods to yield predictable results;

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- Simple substitution of one known element for another to obtain predictable results;
- Use of a known technique to improve similar devices, methods, or products in the same way;
- Applying a known technique to a known device, method, or product ready for improvement to yield predictable results;
- Choosing from a finite number of identified, predictable (*i.e.*, “obvious to try”) solutions, with a reasonable expectation of success;
- Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art;
- Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention; and
- Where references address the same problem, one reference provides a suitable option to help another reference address that problem.

22. I understand that a patent composed of several elements is not proved obvious merely by demonstrating that each element was independently known in the

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prior art. Further, I understand that it is impermissible to use the claimed invention itself as a blueprint for piecing together elements in the art. In other words, it is impermissible to use hindsight reconstruction to pick and choose among disclosures in the prior art to reconstruct the claimed invention.

23. I understand that, where present, objective evidence of nonobviousness or “secondary considerations” must be considered in assessing the obviousness of the claimed invention. I understand that secondary considerations can include failure of others, copying, unexpected results, skepticism by experts, commercial success, and long-felt but unmet need.

24. I understand that evidence of secondary considerations must be reasonably commensurate with the scope of the claims. I understand that for a secondary consideration to be accorded substantial weight, that secondary consideration must have a “nexus” to the claimed invention. Where the secondary consideration results from something other than what is both claimed and novel in the claim, there is no nexus.

B. Indefiniteness

25. I understand that a claim is indefinite when, read in light of the specification and the prosecution history, the claim fails to inform with reasonable certainty those skilled in the art about the scope of the invention.

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26. I understand that a claim can be both obvious and indefinite. For example, if a claim limitation requires alternative features A or B, and feature A is indefinite, but feature B is not, it may be possible to determine that the prior art discloses or renders obvious feature B, thus satisfying the A or B limitation.

C. Claim Construction

27. I understand that in this proceeding, the claims are to be construed according to their ordinary and customary meaning to a person of ordinary skill in the art in light of the specification and the prosecution history of the '917 Patent. (Ex. 1003 ['917 Patent File History].) I understand that this is the same claim construction standard used in district court litigation.

D. Other Relevant Legal Standards

28. I understand that a trust involves three entities: the asset placed in the trust, the trustee of the trust, and the beneficiary of the trust. I understand that when an asset is placed in a trust, the trustee holds the asset for the benefit of the beneficiary.

VI. Technical Background

A. Natural Language Processing

29. Natural language processing (NLP) refers to using a computer to understand and process natural human language. (Ex. 1005 [*Racanelli*] at [0048]; Ex. 1007 [*Bateman*] at [0066].) Examples of NLP tasks include language

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translation, text summarization, and question-answering. (Ex. 1016 [*Liu*] at 1.)

Another example of an NLP task is natural language inference (NLI), which is used to determine whether a premise entails a hypothesis, contradicts a hypothesis, or neither entails nor contradicts a hypothesis. (Ex. 1011 [*Kwak*] at 2.)

30. NLP can also be used to extract structured information from unstructured text. For example, the *Racanelli* reference, a patent application published in 2010, describes using NLP to identify conveyances in wills and other estate planning documents written in natural human language:

“Estate document inputs may be retrieved from a variety of tangible or electronic records including, but not limited to, wills, codicils, revisions, amendments, revocable and irrevocable trusts, living trusts, assignments and other estate planning documents. In one embodiment, these inputs are entered into the estate documents input interface. In another, one or more estate document inputs is retrieved electronically through, for example, natural language processing or reading fields or tags in an electronic estate document format. For example, an algorithm can analyze the text of the will (for example, parsing various instructions or conveyances within the will using templates or masks to recognize common language structures contained in wills such as ‘I [conveyor] leave my car [asset to be conveyed] to my nephew [heir

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(apparent) or intended beneficiary].’) to extract or approximate the conveyances contained therein.”

(Ex. 1005 [*Racanelli*] at [0048].)

31. As another example, the *Bateman* reference, a patent application published in 2015, describes using NLP to extract structured information from human or natural language in wills and other text documents. (Ex. 1007 [*Bateman*] at [0051]-[0052], [0066].) For example, *Bateman* describes using NLP to recognize named entities by extracting names and the types of names from unstructured data, and then to recognize relationships among the extracted named entities, “e.g., who is the wife of whom.” (Ex. 1007 [*Bateman*] at [0066].)

32. The subsequent emergence of large language models facilitated access to sophisticated NLP capabilities. (Ex. 1012 [*Zhao*] at 4, 9.) Large language models are machine-learning models that are fed a prompt—typically a text input provided by the user—which the model then processes to produce an output response based on patterns learned during training. (Ex. 1018 [*White*] at 1-2.)¹ Large language models such as GPT-3.5 made NLP easy to implement and deploy (e.g., via API calls and chat-based interfaces). (Ex. 1012 [*Zhao*] at 1, 10-13.) They were also very popular: ChatGPT, built on the GPT-3.5 architecture, reached 100 million users by

¹ I discuss machine-learning models and training machine-learning models in greater detail in the following section.

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February 2023, making it one of the fastest-growing consumer applications in history and bringing AI into mainstream use across many domains. (Ex. 1014 [*Hu*] at 1; Ex. 1019 [*Bhaimiya*] at 2.) As of 2023, large language models had been applied to a broad array of tasks, such as language generation; sentiment analysis; data visualization; and data analysis, among other examples. (Ex. 1012 [*Zhao*] at 59; Ex. 1013 [*Fatouros*] at 1; Ex. 1015 [*Maddigan*] at 1; Ex. 1016 [*Liu*] at 8; Ex. 1017 [*Morgan*] at 1.)

B. Machine Learning and Training a Machine-Learning Model

33. At a high level, a machine-learning model is a computer model that “learns” by applying an algorithm (or algorithms) to training data to learn patterns and make predictions or decisions based on that data. (Ex. 1007 [*Bateman*] at [0070], [0072].) Examples of algorithms for machine learning include naïve Bayes, SMO (SVM) (support vector machines), Cl. via Regression, Decision Tree, Bagging, Majority Vote, Random Forest, and decision trees. (Ex. 1008 [*Curtotti*] at 6; Ex. 1013 [*Fatouros*] at 3.)

34. A machine-learning model can be trained via supervised learning, which is based on the idea of providing “labeled” data, where each input example is paired with a correct output or classification, typically generated or annotated by humans. (Ex. 1008 [*Curtotti*] at 6; Ex. 1011 [*Kwak*] at 3.) For instance, a dataset might contain images of apples labeled as “fruit” and images of carrots labeled as

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“vegetable,” teaching the model to properly classify new, unseen examples into the correct categories. As another example of supervised learning, *Bateman* describes a language processing model trained on unstructured text documents and their corresponding human-generated structured conveyance records. (Ex. 1007 [*Bateman*] at [0070].) Although human annotation and pre-existing labels can make supervised machine-learning resource-intensive, supervised machine learning is highly effective for tasks where clear right answers exist.

35. A machine-learning model can also be trained via unsupervised learning. Unsupervised learning involves training models on data without explicit labels, allowing the algorithm to discover hidden patterns, structures, or relationships within the data on its own. (Ex. 1012 [*Zhao*] at 7, 82.)

36. Machine-learning techniques could be complemented by hand-coded rules. (Ex. 1007 [*Bateman*] at [0072]; Ex. 1008 [*Curtotti*] at 2-3.) For example, the 2010 *Curtotti* reference surveys literature on combining hand-coded rules with machine learning for tasks such as categorizing emails, classifying spoken utterances, and classifying occupations from social surveys. (Ex. 1008 [*Curtotti*] at 2-3.) *Curtotti* also describes using hand-coded rules to improve the accuracy of machine learning for classifying components of contracts. (Ex. 1008 [*Curtotti*] at 1.) As another example, *Bateman* describes training a language processing model

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with both machine-learning algorithms and hand-coded rules to extract structured conveyance records from a text document. (Ex. 1007 [*Bateman*] at [0070], [0072].)

C. Using Machine-Learning Models to Extract Structured Information from Documents

37. Using machine-learning models to extract structured information from documents was well-known before November 2023. The 2015 *Bateman* reference provides an example of a machine-learning model that extracts structured information from documents. *Bateman* describes a language processing model trained with machine-learning algorithms that can extract, from documents such as wills, structured conveyance records reflecting transfers of interests in property. (Ex. 1007 [*Bateman*] at [0051]-[0052], [0063], [0070], [0072], [0074], [0108].) The structured conveyance records can include data reflecting a plot of land in which in interest is conveyed; a grantor of the conveyance; a grantee of the conveyance; the interest conveyed; and other information. (Ex. 1007 [*Bateman*] at [0074], [0108].)

38. Further, a common use of LLMs and ChatGPT and its underlying APIs for GPT-3.5, GPT-4, and other models as of November 2023 was the extraction of structured data from unstructured information. (Ex. 1012 [*Zhao*] at 73-74; Ex. 1016 [*Liu*] at 7; Ex. 1018 [*White*] at 12.) For example, in March 2023, I published "Prompt Patterns: A Catalog for Enhancing Prompt Engineering with ChatGPT," which included the Template Pattern for extracting structured data by providing the model with a template showing the exact format expected in the output, whether URL,

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JSON, CSV, or other structured formats. (Ex. 1018 [*White*] at 12.) The Template Pattern enabled users to specify field names, data types, and output structure, ensuring the model would return information in a format that could be directly integrated into downstream systems and applications. (Ex. 1018 [*White*] at 12.)

VII. Level of Ordinary Skill in the Art

39. I understand that it is necessary to analyze both a patent's claims and the prior art from the perspective of a person of ordinary skill in the art at the time of the invention. Thus, my analysis and opinions in this declaration are from the perspective of a person of ordinary skill in the art.

40. I understand that factors that may be considered in determining the level of ordinary skill in the art include: (1) the educational level of the inventor or inventors; (2) the type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field. I understand that those factors are not exhaustive, but merely a guide to determining the level of ordinary skill in the art.

41. Based on my consideration of those factors in light of my first-hand experience, it is my opinion that a person of ordinary skill in the art at the time of the invention of the '917 Patent would have had an undergraduate degree in computer science or a related field, and three to five years of industry experience

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with artificial intelligence and machine learning. This level of skill is approximate, and more education could have compensated for less experience, and vice versa.

42. I have enough education and experience to qualify as a person of ordinary skill in the art at the time of the invention of the '917 Patent.

VIII. Prosecution History

43. I have considered the full prosecution history of the '917 Patent and its parent provisional application. (Ex. 1002 [Provisional App. No. 63/603,895]; Ex. 1003 ['917 Patent File History].) I address that prosecution history where it affects my opinions.

IX. Claim Construction

A. “one or more relationships between the one or more entities” (Claims 4 and 5)

44. The term “one or more relationships between the one or more entities” includes a logical impossibility: a relationship “between” one entity. I explain why a relationship “between” one entity is a logical impossibility in **Section XII.E**.

45. However, the term “one or more relationships between the one or more entities” also includes, as an alternative to a relationship “between” one entity, a relationship between multiple entities. The prior art teaches a relationship between multiple entities, as I discuss below for Claim 4 in **Section XII.B.4**.

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B. Other Claim Terms

46. For all other claim terms, I have applied the ordinary and customary meaning of that claim term in light of the specification and prosecution history of the '917 Patent.

X. Overview of the Prior Art

A. *Racanelli* (Ex. 1005)

47. *Racanelli* generally describes an estate planning system. “Various disclosed embodiments are generally directed to a system and computer-implemented method of modeling estate disposition.” (Ex. 1005 [*Racanelli*] at [0028].) In particular, *Racanelli* provides visualizations of asset allocations:

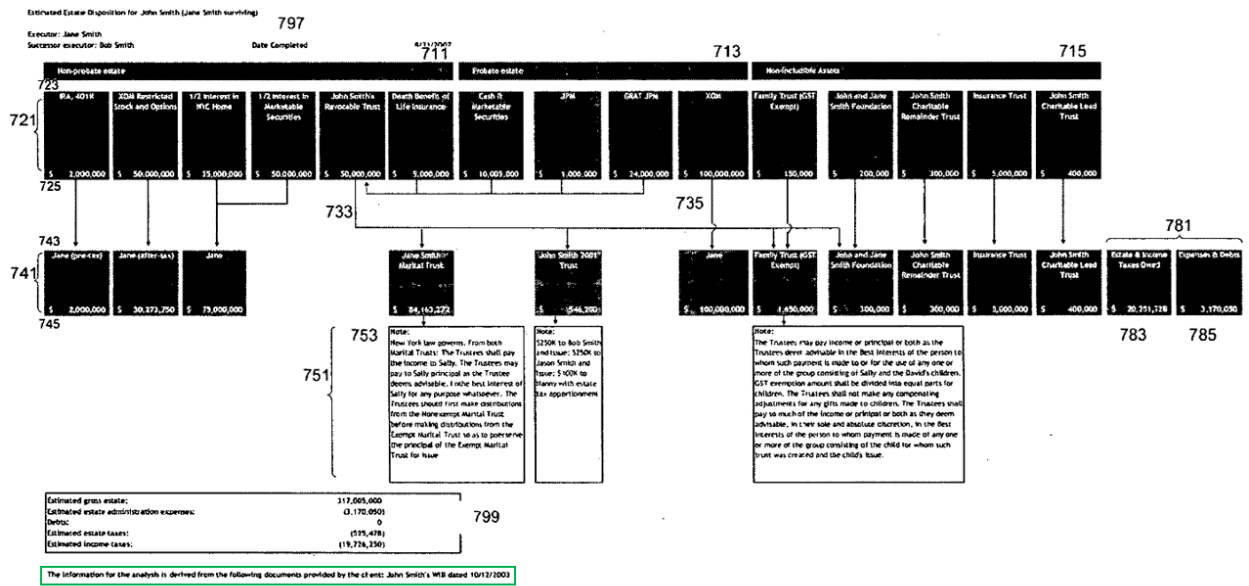
“Various disclosed embodiments advantageously allow for a user, such as a wealth advisor or estate planner, to efficiently and easily customize visual representations of the disposition of a client’s estate based on various customizable circumstances. Further, disclosed embodiments allow the client to view the allocation or distribution of their assets and liabilities in their estate plan at a given time and under a variety of simulated circumstances.”

(Ex. 1005 [*Racanelli*] at [0084].)

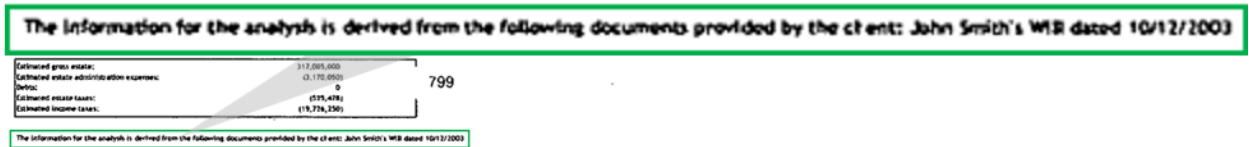
48. As an example, *Racanelli* describes generating flowcharts that depict the flow of assets to beneficiaries. (Ex. 1005 [*Racanelli*] at [0029].) Examples of those flowcharts include Figure 7, which depicts the flow of assets to beneficiaries

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under **John Smith's will**; and Figure 8, which depicts the flow of assets to beneficiaries under spouse **Jane Smith's will**, as indicated by the legends at the bottom left of each of those figures:

Figure 7



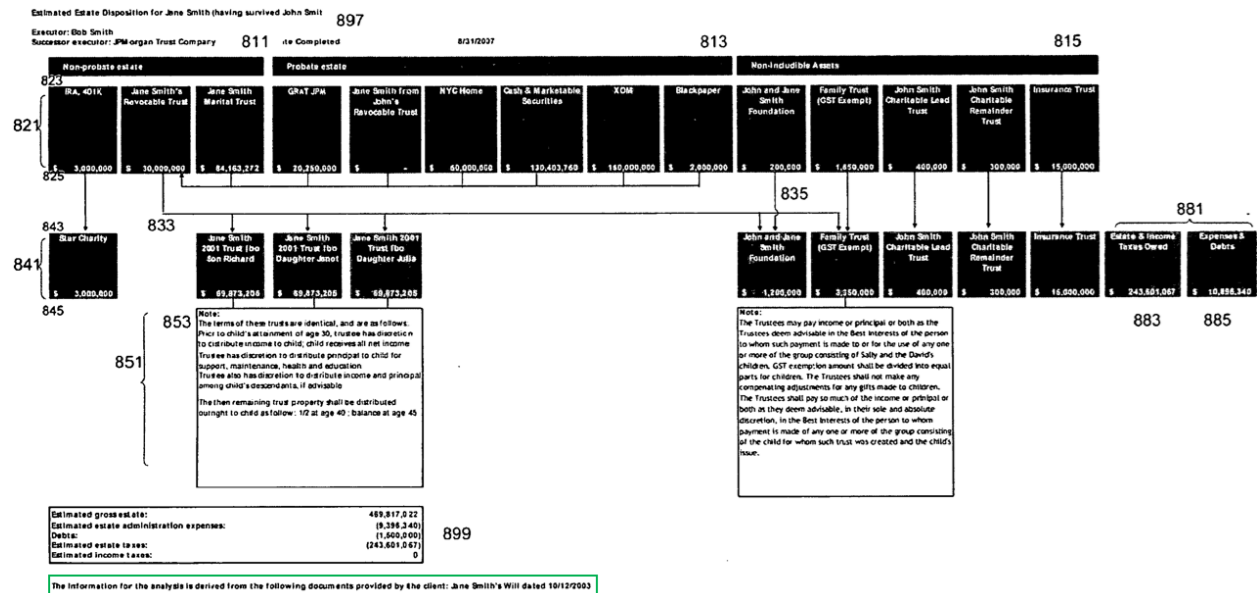
(Ex. 1005 [Racanelli] at Fig. 7 (annotations added).)



(Ex. 1005 [Racanelli] at Fig. 7 (detail; annotations and callout added).)

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Figure 8



(Ex. 1005 [Racanelli] at Fig. 8 (annotations added).)



(Ex. 1005 [Racanelli] at Fig. 8 (detail; annotations and callout added).)

49. *Racanelli* describes generating those flowcharts from balance sheet inputs and estate document inputs. (Ex. 1005 [Racanelli] at [0029].) Estate document inputs include provisions of a will that allocate assets to recipients, which *Racanelli* describes identifying using natural language processing:

“Estate document inputs may be retrieved from a variety of tangible or electronic records including, but not limited to, wills, codicils, revisions, amendments, revocable and irrevocable trusts, living trusts, assignments and other estate planning documents. In one embodiment, these

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inputs are entered into the estate documents input interface. In another, one or more estate document inputs is retrieved electronically through, for example, natural language processing or reading fields or tags in an electronic estate document format. For example, an algorithm can analyze the text of the will (for example, parsing various instructions or conveyances within the will using templates or masks to recognize common language structures contained in wills such as ‘I [conveyor] leave my car [asset to be conveyed] to my nephew [heir (apparent) or intended beneficiary].’) to extract or approximate the conveyances contained therein.”

(Ex. 1005 [*Racanelli*] at [0048].)

50. *Racanelli* also describes that “disclosed embodiments allow the client to view the allocation or distribution of their assets and liabilities in their estate plan at a given time and under a variety of simulated circumstances.” (Ex. 1005 [*Racanelli*] at [0084].) For example, *Racanelli* describes projecting the growth or contraction of the assets of an estate over time, such as the time between death of a first spouse and a second spouse. (Ex. 1005 [*Racanelli*] at [0051], [0067].) *Racanelli* also incorporates by reference U.S. Patent No. 7,031,935 to Chhabbra et al., which generally describes determining statistical wealth projections. (Ex. 1005 [*Racanelli*] at [0051]; Ex. 1006 [*Chhabbra*] at 1:7-11.)

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B. *Bateman* (Ex. 1007)

51. *Bateman* describes a language processing model that can generate structured conveyance records that reflect conveyances of real property and interests in real property from the text of a document including those conveyances. (Ex. 1007 [*Bateman*] at [0063], [0074], [0108].) *Bateman* describes operating on documents that have undergone optical character recognition. (Ex. 1007 [*Bateman*] at [0051].) *Bateman* describes that the language processing model can operate on many types of documents that convey property or interests in property, such as wills. (Ex. 1007 [*Bateman*] at [0051]-[0052], [0063], [0074].) The structured conveyance records can include data reflecting a plot of land in which in interest is conveyed; a grantor of the conveyance; a grantee of the conveyance; the interest conveyed; and other information. (Ex. 1007 [*Bateman*] at [0074], [0108].)

52. *Bateman* describes training its language processing model on hand-coded rules and machine-learning algorithms. (Ex. 1007 [*Bateman*] at [0070], [0072].) *Bateman* incorporates the *Curtotti* reference, which describes combining hand-coded rules with machine-learning algorithms to classify components of contracts. (Ex. 1007 [*Bateman*] at [0072]; Ex. 1008 [*Curtotti*] at 1.) *Bateman* also describes training its language processing model on unstructured text documents (such as wills) and corresponding structured conveyance records from a human reviewer who analyzed the documents manually. (Ex. 1007 [*Bateman*] at [0070].)

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53. In generating structured conveyance records, *Bateman*'s language processing model can incorporate human review. For example, *Bateman*'s language processing model may extract only some of the values for the parameters of a conveyance record, while a human provides the rest of them by selecting from among candidate values identified by the language processing model:

“Extracting conveyance records may include extracting only some parameters of such records and extracting likely candidate values for such parameters. In some cases, natural language processing may be sufficient to extract, for example, four of eight parameters of a conveyance record, and other parameters may be supplied by a human reviewer. In some cases, extracting conveyance record parameters may include identifying a set of candidate values, ranking the candidate values according to likelihood of being the correct value as scored by the language processing model, and associating the ranking with the conveyance record, such that a human reviewer may select among the same.”

(Ex. 1007 [*Bateman*] at [0071].)

54. As a specific example, *Bateman* describes its language processing model identifying candidate names and roles for the grantor and grantee of a conveyance, prompting a human to select the correct names and roles, and applying the user's selection to the structured conveyance record:

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“Some embodiments may, after identifying candidate names, identify candidate roles and then compare distances therebetween to select a conveyor name and a conveyee name. In cases where multiple candidate names are detected, some embodiments may associate the candidates with a corresponding conveyance record field, and a human reviewer may select among the candidates during human review. The received selection, upon receipt, may be applied to the corresponding conveyance record.”

(Ex. 1007 [*Bateman*] at [0067].)

C. *Dintenfass* (Ex. 1009)

55. *Dintenfass* “relates generally to allocating assets” and specifically to “assessment of allocated assets by transforming information received from one or more sources of user assets in real-time.” (Ex. 1009 [*Dintenfass*] at [0001].)

Dintenfass describes a system, computer program product, and methods “for a system to determine and reallocate assets by transforming information received from one or more sources of user assets in real-time (e.g., instantaneously or near instantaneously).” (Ex. 1009 [*Dintenfass*] at [0003].) *Dintenfass* particularly provides an estate portal application that includes a will generation application for generating and updating a will. (Ex. 1009 [*Dintenfass*] at [0057], [0060], [0064].)

56. User assets can include “accounts of the user and/or other property owned by the user.” (Ex. 1009 [*Dintenfass*] at [0023].) An asset may be associated

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with an account: “Examples of assets associated with accounts may be accounts that have cash or cash equivalents, or accounts that are funded with or contain property, such as safety desposits [deposit] box account that jewelry, a trust account that is funded with property, or the like.” (Ex. 1009 [*Dintenfass*] at [0023].) Other examples of assets associated with accounts are checking accounts, savings accounts, investment accounts, annuity accounts, and insurance benefits accounts. (Ex. 1009 [*Dintenfass*] at [0046].) Other user assets may not be associated with an account, such as “antiques in a user’s home, jewelry in a user’s home, or the like.” (Ex. 1009 [*Dintenfass*] at [0023].)

57. *Dintenfass* describes continuously monitoring real-time data feeds from sources of user assets, including over the Internet. “In some embodiments, the system may be configured for selectively monitoring one or more real-time data feeds from the one or more sources of user assets and financial status of the beneficiaries. These feeds can be provided via wireless network path portions through the Internet.” (Ex. 1009 [*Dintenfass*] at [0049].) *Dintenfass* further describes updating an estate planning display in real-time based on changes in the values of the continuously monitored assets. “In some embodiments, the module is further configured to continuously monitor the one or more sources of user assets; and update the asset value of the user assets associated with the one or more sources of user assets in real-time for display on the estate portal application.” (Ex. 1009

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[*Dintenfass*] at [0006].) “In response to continuously monitoring the real-time data feeds, the system may be configured to update the asset value associated with the one or more sources of user assets and/or financial status of the beneficiaries in real-time for display on the estate portal application.” (Ex. 1009 [*Dintenfass*] at [0049].)

58. *Dintenfass* also describes checking a will that a user has prepared against laws to identify any discrepancies between the asset allocations in the will and state law. (Ex. 1009 [*Dintenfass*] at [0057], [0059].) As *Dintenfass* explains, certain asset allocations in a will may be prohibited under state law, such as omitting a surviving spouse as a beneficiary. (Ex. 1009 [*Dintenfass*] at [0057].) *Dintenfass* therefore describes retrieving current state law and checking a will’s asset allocations against that state law to identify any discrepancies, and to alert the user so that the user can correct the discrepancy. (Ex. 1009 [*Dintenfass*] at [0059].)

59. Finally, *Dintenfass* describes receiving new information about a change in state laws or regulations that require updating a will and notifying a user to update *Dintenfass*’s estate portal application based on that new information:

“In some embodiments, the system may be configured to transmit a notification to the user indicating that the user may have to update the estate portal application based on new information. For example, the new information may include a death of a beneficiary, change in state or regulatory laws since the generation of the previous will, change in the residency of the user, or the like.”

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(Ex. 1009 [*Dintenfass*] at [0064].)

D. *McMillen* (Ex. 1010)

60. *McMillen* generally describes a digital estate planning system for managing beneficiaries and assets of a will. (Ex. 1010 [*McMillen*] at Abstract.) In particular, *McMillen* discloses a digital estate planning system that enables authorized users and designated parties to interact with and manage will elements—including assets, beneficiaries, and bequests—through an online platform. (Ex. 1010 [*McMillen*] at [0018], [0027].)

61. *McMillen* explains that “[i]t is not uncommon to have to change or update a will.” (Ex. 1010 [*McMillen*] at [0028].) *McMillen* further explains that life events that may cause the need to change a will can include “a marital status change, a birth or death of a named or potential beneficiary, moving to a new location with different intestate laws, the acquisition or disposal of property, or the death of a named executor, or a change in tax laws, just to list a few examples.” (Ex. 1010 [*McMillen*] at [0028].)

62. Accordingly, *McMillen*’s system can “detect potential new beneficiaries or new assets by analyzing transactional histories of the user.” (Ex. 1010 [*McMillen*] at [0028].) *McMillen* discloses that its system accesses transaction data related to a user from sources such as banking, brokerage, insurance, credit

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bureau, tax, and social media systems in order to track assets, relationships, and transactions relevant to estate planning. (Ex. 1010 [*McMillen*] at [0028]-[0029].)

63. Upon detecting a potential change in assets or beneficiaries, *McMillen's* system notifies the user the need to update the user's will. (Ex. 1010 [*McMillen*] at [0038], [0041], [0043], [0045], [0047].) *McMillen* further describes providing that notification via email, text message, or pop-up user interface elements. (Ex. 1010 [*McMillen*] at [0041], [0043], [0045], [0047].)

64. In addition to its event detection and notification functions, *McMillen* describes a machine-learning technique for projecting an asset's value. *McMillen* describes using a machine-learning model to both associate an image with an asset and to process data associated with the asset (including the image) to generate a valuation estimate for the asset. (Ex. 1010 [*McMillen*] at [0013], [0015].)

65. To start, *McMillen* describes determining a baseline valuation of the asset based on images reflecting the asset's condition:

“At 404, a baseline valuation is determined. The baseline valuation may be based on a manufacturer's suggested retail price (MSRP), a standard valuation (e.g., a Bluebook value), a purchase price, or the like.

At 406, a user is prompted for an image of the asset. The user may be working within a graphical user interface (GUI) on an estate planning online system, such as online

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system 106. The user may upload an image file that is saved on the user's computer, for instance.

At 408, the baseline valuation is revised based on the image. Image analysis may provide hints on the condition, size, amount, or other features of an asset. The valuation is revised and stored in a data store, such as database 110 in online system 106.”

(Ex. 1010 [*McMillen*] at [0058]-[0060].)

66. The machine learning model can use the adjusted baseline valuation and a depreciation (or appreciation) function to project the asset's future value:

“An image-based valuation may be adjusted as time continues. For instance, a vehicle may have a Bluebook value of \$5000. One or more images are provided that shows the interior and exterior of the vehicle are in excellent condition. As such, the image-based valuation is increased by 10% to \$5500. Over time, the valuation is reduced at some rate consistent with the type of asset. Here, the vehicle may be depreciated on a progressive scale of 20% after the first year, 15% per year for the next four years, and then 10% per year for the remaining years in service. The make, model, type, and other factors may be used to adjust the depreciation function. Further, it is understood that assets may appreciate in value, or appreciate or depreciate at different amounts or for specific reasons.”

(Ex. 1010 [*McMillen*] at [0062].)

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E. Kwak (Ex. 1011)

67. *Kwak* generally describes using machine-learning models to assess the validity of will statements. (Ex. 1011 [*Kwak*] at 1.) *Kwak* explores how natural-language inference (NLI) machine-learning models “can be employed to evaluate the validity of will statements” under state laws and factual conditions. (Ex. 1011 [*Kwak*] at 1.) “We trained multiple NLI models with our dataset to assess their performance: four transformer models and four sentence-transformer models.” (Ex. 1011 [*Kwak*] at 4.) The dataset input into the NLI models includes the will provisions to be assessed; state laws; and factual conditions. (Ex. 1011 [*Kwak*] at 1.)

68. *Kwak* also reports that the trained models performed satisfactorily: “Overall, the models demonstrated good performances. Each achieved more than 80% in all metrics but group accuracy. Roberta-large-mnli showed the best performance.” (Ex. 1011 [*Kwak*] at 5.) While recommending human-in-the-loop review to improve the performance of the trained models, *Kwak* nonetheless reports that “[t]he NLI models trained on our dataset showed reasonable performance in assessing the validity of will statements.” (Ex. 1011 [*Kwak*] at 9.)

XI. Summary of Opinions

69. Claims 1-20 of the '917 Patent include features that would have been well-understood, routine, and conventional to a person of ordinary skill in the art. I discuss that opinion in **Section XII.A.**

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70. Claims 1, 2, 4-7, 12-14, 17, and 19 of the '917 Patent would have been obvious to a person of ordinary skill in the art in light of the combined teachings of *Racanelli*, *Bateman*, and *Dintenfass*. I discuss that opinion in **Section XII.B**.

71. Claims 3 and 8-11 of the '917 Patent would have been obvious to a person of ordinary skill in the art in light of the combined teachings of *Racanelli*, *Bateman*, *Dintenfass*, and *McMillen*. I discuss that opinion in **Section XII.C**.

72. Claims 15, 16, 18, and 20 would have been obvious to a person of ordinary skill in the art in light of the combined teachings of *Racanelli*, *Bateman*, *Dintenfass*, and *Kwak*. I discuss that opinion in **Section XII.D**.

73. Claims 4 and 5 of the '917 Patent include the feature “one or more relationships between one or more entities.” That feature includes a logical impossibility: a relationship “between” only one entity. I discuss that opinion in **Section XII.E**.

XII. Opinions

A. Claims 1-20 include features that would have been well-understood, routine, and conventional to a person of ordinary skill in the art.

74. In this section, I discuss features of Claims 1-20 that would have been well-understood, routine, and conventional to a person of ordinary skill in the art as of November 29, 2023. Those features are also reflected in the prior art that I discuss in **Sections XII.B through XII.D**.

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1. Machine-learning models were well-understood, routine, and conventional.

75. Machine learning models were well-understood, routine, and conventional as of November 29, 2023. By that time, the field of machine learning had undergone rapid evolution and widespread adoption, particularly following the introduction of large language models (LLMs) such as ChatGPT. Large language models are machine learning models that are fed a prompt which the model processes to produce an output based on patterns learned during training. By February of 2023, ChatGPT had already reached over 100 million users, becoming the fastest-growing consumer application in history and propelling advanced machine learning capabilities into mainstream use for everyday consumers. (Ex. 1014 [*Hu*] at 1; Ex. 1019 [*Bhaimiya*] at 2.)

76. Academic publications also establish that machine learning models were well-understood, routine, and conventional as of November 29, 2023. *Curtotti*, for example, surveyed literature about combining machine-learning approaches with hand-coded rules in 2010. (Ex. 1008 [*Curtotti*] at 2-3.) I also published about machine learning models in my February 2023 paper “Prompt Patterns: A Catalog for Enhancing Prompt Engineering with ChatGPT.” (Ex. 1018 [*White*].) Academic reviews such as *Liu* and *Zhao* also documented the widespread adoption and mainstream use of machine-learning models prior to and as of November 29, 2023.

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(Ex. 1016 [*Liu*]; Ex. 1012 [*Zhao*].) Those citations reflect broad familiarity with machine-learning models as of November 29, 2023.

77. The prior art that I discuss also reflects that machine-learning models were well-understood, routine, and conventional as of November 29, 2023. For example, *Bateman*, a patent application filed in April 2015 and published in October 2015, describes a machine-learning model for extracting structured conveyance records from the text of documents such as wills. (Ex. 1007 [*Bateman*] at Cover, [0063], [0070]-[0072], [0074], [0108].) *Bateman* incorporates the even older *Curtotti* reference, which describes combining hand-coded rules with machine-learning algorithms to classify components of contracts. (Ex. 1007 [*Bateman*] at [0072]; Ex. 1008 [*Curtotti*] at 1.) *Curtotti* also identifies seven known machine-learning algorithms: naïve Bayes, SMO (SVM), Cl. via Regression, Decision Tree, Bagging, Majority Vote, and Random Forest. (Ex. 1008 [*Curtotti*] at 6.)

78. As another example, *McMillen* describes using machine-learning models to (1) project asset valuations (Ex. 1010 [*McMillen*] at [0013], [0015], [0058]-[0060], [0062]); and (2) detect events that might require changing a will. (Ex. 1010 [*McMillen*] at [0039]-[0040].) As an example of using machine learning to detect events that might require changing a will, *McMillen* describes using a machine-learning model trained to analyze bank statements, credit bureau reports,

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electronic images of checks, and account statements to identify potential new assets or beneficiaries to address in the will. (Ex. 1010 [*McMillen*] at [0051]-[0056].)

79. As yet another example, *Kwak* describes using machine-learning models to analyze the validity of provisions in wills based on state laws and factual conditions. (Ex. 1011 [*Kwak*] at 1, 4.) *Kwak* also reports that the trained models performed satisfactorily: “Overall, the models demonstrated good performances. Each achieved more than 80% in all metrics but group accuracy. Roberta-large-mnli showed the best performance.” (Ex. 1011 [*Kwak*] at 5.) While recommending human-in-the-loop review to improve the performance of the trained models, *Kwak* nonetheless reports that “[t]he NLI models trained on our dataset showed reasonable performance in assessing the validity of will statements.” (Ex. 1011 [*Kwak*] at 9.)

2. Machine-learning models trained on desired output data were well-understood, routine, and conventional.

80. Machine-learning models trained on desired output data were also well-understood, routine, and conventional as of November 29, 2023. By that time, it was standard practice to train machine-learning models using outputs that represent the correct solution to a given task.

81. As I discuss in **Section VI** and adopt here, training machine-learning models requires providing training data so that models can learn patterns and make predictions or decisions based on that data. This training data may be categorized as either supervised or unsupervised. In supervised learning, each input example is

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paired with its correct output or classification. The use of supervised learning and specifically, the practice of training machine-learning models on desired output data, was well-understood, routine, and conventional as of November 29, 2023.

82. *Bateman*, which was filed in April 2015 and published in October 2015, provides an example of supervised learning. (Ex. 1007 [*Bateman*] at Cover.) *Bateman* describes training a machine-learning language processing model on unstructured text documents and structured conveyance records generated from those documents and validated by a human reviewer, which serve as the desired output: “A machine-learning algorithm, applied to a language processing model, may be trained, at least in part, on unstructured text documents and corresponding structured conveyance records (e.g., a collection of different instruments from a given jurisdiction and their corresponding runsheets as previously analyzed manually by a human reviewer).” (Ex. 1007 [*Bateman*] at [0070].) *Kwak* provides another example of supervised learning before November 29, 2023, in which human annotators labeled will statements as “support,” “refute,” or “unrelated” based on a given condition and state law, then used approximately 50% of the annotated will statements as training data for machine-learning models to assess the validity of test will statements. (Ex. 1011 [*Kwak*] at 3-4.)

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3. Machine-learning models trained on rule data were well-understood, routine, and conventional.

83. Machine-learning models trained on “rule data” were also well-understood, routine, and conventional as of November 29, 2023.

84. The prior art that I discuss reflects that machine-learning models trained on rule data were well-understood, routine, and conventional as of November 29, 2023. For example, *Bateman*, a patent application filed in April 2015 and published in October 2015, describes training a machine-learning model with hand-coded rules to extract structured conveyance records from the text of documents such as wills. (Ex. 1007 [*Bateman*] at Cover, [0051]-[0052], [0063], [0070], [0072], [0074], [0108].) *Bateman* also describes training the machine-learning model on unstructured text documents such as wills that include provisions conveying interests in property. (Ex. 1007 [*Bateman*] at [0051]-[0052], [0070].) Those training will provisions are also rule data, as the '917 Patent describes that “rule data” can include provisions of a will: “Further, the one or more rules can be based on one or more provisions of the one or more resource documents (e.g., network policy documents, estate documents, an estate plan, provisions of a will, trust, healthcare directive, power of attorney, and/or insurance policy).” (Ex. 1001 ['917 Patent] at 8:41-45.)

85. *Bateman* incorporates the even older *Curtotti* reference, which in turn surveys academic literature on use of hand-coded rules to train machine-learning models. (Ex. 1007 [*Bateman*] at [0072]; Ex. 1008 [*Curtotti*] at 2.) *Curtotti* also

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describes the use of hand-coded rules to train machine learning for classifying components of contracts. (Ex. 1008 [*Curtotti*] at 2-4.)

86. As another example, *Kwak* describes using machine-learning models to analyze the validity of provisions in wills based on state laws and factual conditions. (Ex. 1011 [*Kwak*] at 1, 4.) *Kwak* also reports that the trained models performed satisfactorily: “Overall, the models demonstrated good performances. Each achieved more than 80% in all metrics but group accuracy. Roberta-large-mnli showed the best performance.” (Ex. 1011 [*Kwak*] at 5.) While recommending human-in-the-loop review to improve the performance of the trained models, *Kwak* nonetheless reports that “[t]he NLI models trained on our dataset showed reasonable performance in assessing the validity of will statements.” (Ex. 1011 [*Kwak*] at 9.)

B. Claims 1, 2, 4-7, 12-14, 17, and 19 would have been obvious over *Racanelli* in view of *Bateman* and *Dintenfass*.

1. Combination of *Racanelli*, *Bateman*, and *Dintenfass*

i. *Racanelli*, *Bateman*, and *Dintenfass* qualify as analogous art to the '917 Patent.

87. *Racanelli*, *Bateman*, and *Dintenfass* qualify as analogous art to the '917 Patent at least because those references are in the same field of endeavor as the '917 Patent: resource allocation.

88. The '917 Patent belongs to the field of resource allocation. The title of the '917 Patent reflects that field: “EVENT-BASED RESOURCE ALLOCATION

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SYSTEM.” (Ex. 1001 [’917 Patent] at Cover.) The first sentence of the abstract also reflects that field: “Provided are methods, systems, devices, apparatuses, and tangible non-transitory computer readable media for processing and allocating resources.” (Ex. 1001 [’917 Patent] at Abstract.)

89. The ’917 Patent’s specification also explains that the ’917 Patent belongs to the field of resource allocation. For example, the “FIELD” section of the specification explains that the ’917 Patent generally relates to resource allocation: “The present disclosure relates generally to event-based resource allocation systems. More particularly, the present disclosure relates to computing systems that are configured to generate resource data and implement rules-based techniques and machine-learning models that can process, allocate, and automatically update the resource data.” (Ex. 1001 [’917 Patent] at 1:6-11.)

90. The “DETAILED DESCRIPTION” section of the specification also explains that the ’917 Patent relates to resource allocation. “In general, the present disclosure is directed to generating and processing data including resource data associated with resource processing and allocation.” (Ex. 1001 [’917 Patent] at 3:66-4:1.) The detailed description continues, “In accordance with this disclosure, a personalized analysis of resource allocation instructions including data relating to the assets and entities associated with the resources can be generated and used to automatically deal with various aspects of resources planning.” (Ex. 1001 [’917

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Patent] at 4:1-6.) “Additionally, the present disclosure is directed to improved computer systems, computer applications, computer-implemented methods, user interfaces, and/or services for resource processing and/or allocation.” (Ex. 1001 [’917 Patent] at 4:21-24.)

91. The ’917 Patent’s claims also show that the ’917 Patent belongs to the field of resource allocation. Independent Claims 1, 17, and 19 each include features related to resource allocation. For example, independent Claims 1, 17, and 19 include “generating . . . based on inputting one or more resource documents into one or more machine-learning models, one or more prompts comprising requests for information associated with resource allocation instructions for distribution of resources, wherein the one or more machine-learning models are configured to generate the one or more prompts based on recognition of textual features of the one or more resource documents associated with the resources, wherein the one or more resource documents comprise one or more resource document fields, and wherein the resource allocation instructions are associated with distribution of one or more assets of the resources to one or more entities comprising one or more resource recipients.” (Ex. 1001 [’917 Patent] at Claims 1, 17, and 19 (underlining added).) Those claims also include “generating . . . one or more indications associated with the resource allocation instructions, wherein the one or more indications comprise one or more visualizations of the distribution of the one or more assets to the one or

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more resource recipients.” (Ex. 1001 [’917 Patent] at Claims 1, 17, and 19 (underlining added).)

92. The ’917 Patent’s specification identifies estate planning as an example of resource allocation. It twice describes an estate plan as “resource allocation instructions to distribute assets of an estate.” (Ex. 1001 [’917 Patent] at 7:56-60, 9:2-8.) It similarly describes “resource documents” used for estate planning, such as wills and trusts. (Ex. 1001 [’917 Patent] at 7:32-46, Claim 12.) References that belong to the field of estate planning thus belong to the field of resource allocation.

93. Like the ’917 Patent, *Racanelli* belongs to the field of resource allocation. *Racanelli* describes “[a] system and computer-implemented method for modeling estate disposition”—*i.e.*, estate planning, a form of resource allocation. (Ex. 1005 [*Racanelli*] at Abstract.) *Racanelli*’s “disclosed embodiments allow the client to view the allocation or distribution of their assets and liabilities in their estate plan at a given time and under a variety of simulated circumstances.” (Ex. 1005 [*Racanelli*] at [0084].) *Racanelli* further describes analyzing the text of a will to determine how the will allocates resources (assets of an estate) to beneficiaries:

“For example, an algorithm can analyze the text of the will (for example, parsing various instructions or conveyances within the will using templates or masks to recognize common language structures contained in wills such as ‘I [conveyor] leave my car [asset to be conveyed] to my

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nephew [heir (apparent) or intended beneficiary].’) to extract or approximate the conveyances contained therein.”

(Ex. 1005 [*Racanelli*] at [0048].)

94. Like the ’917 Patent, *Bateman* belongs to the field of resource allocation. *Bateman* “relates generally to computer systems and, more specifically, to real property rights management systems and methods.” (Ex. 1007 [*Bateman*] at [0003].) Similar to *Racanelli*, *Bateman* describes analyzing documents such as wills to identify legally operative conveyances of interests in real property, which allocate (convey) resources (interests in real property). (Ex. 1007 [*Bateman*] at [0008], [0051]-[0052].) *Bateman* further describes extracting “structured conveyance records” reflecting conveyances of interests in real property from those documents, which structured records can include the name of the grantor; the name of the grantee; a description of the land to which the conveyance pertains; and the type of interest conveyed. (Ex. 1007 [*Bateman*] at [0059], [0063], [0074], [0108].) The structured conveyance records reflect allocations of a resource (such as an interest in land) from the grantor (a previous owner of the interest) to the grantee (the interest’s recipient).

95. Like the ’917 Patent, *Dintenfass* belongs to the field of resource allocation. *Dintenfass* “relates generally to allocating assets” and specifically to “assessment of allocated assets by transforming information received from one or

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more sources of user assets in real-time.” (Ex. 1009 [*Dintenfass*] at [0001].)

Dintenfass describes a system, computer program product, and methods “for a system to determine and reallocate assets by transforming information received from one or more sources of user assets in real-time (e.g., instantaneously or near instantaneously).” (Ex. 1009 [*Dintenfass*] at [0003].) *Dintenfass* also belongs to the field of resource allocation in that *Dintenfass* describes an estate portal application that provides estate planning functions, including (1) generating a draft of a will that allocates assets to beneficiaries; and (2) generating an alert when a will’s asset allocation conflicts with state law. (Ex. 1009 [*Dintenfass*] at [0057]-[0059].)

ii. Persons of ordinary skill in the art would have been motivated to combine the teachings of *Racanelli*, *Bateman*, and *Dintenfass*.

96. In this section, I explain how and why persons of ordinary skill in the art would have combined the teachings of *Racanelli*, *Bateman*, and *Dintenfass*. *First*, persons of ordinary skill in the art would have been to provide *Racanelli*’s computing system with *Bateman*’s techniques for identifying conveyances of assets and interests in assets in documents such as wills and for generating structured data about those conveyances. *Second*, persons of ordinary skill would have been motivated to provide *Racanelli*’s computing system with *Dintenfass*’s techniques for monitoring asset values in real-time and updating an estate planning visualization in real-time as asset values change.

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Persons of ordinary skill in the art would have been motivated to provide Racanelli's computing system with Bateman's techniques for identifying conveyances of assets and interests in assets in documents such as wills and for generating structured data about those conveyances.

97. *Racanelli* describes a computing system that implements the techniques that *Racanelli* discloses: “Figure 15 is a schematic diagram of an exemplary computing system environment 1500 for use in implementing one or more of the disclosed embodiments. As understood by those of ordinary skill in the art, the various embodiments disclosed herein may be implemented by or include a computer or computers.” (Ex. 1005 [*Racanelli*] at [0070].)

98. *Racanelli* describes generating flowcharts to visualize a client's estate plan. The flowcharts are based on estate document inputs and balance sheet inputs:

“Generally, various disclosed embodiments receive balance sheet 103 and estate document inputs 105 corresponding to an estate planning client, apply conveyance 109, taxation 111 and other 107 logic to the client's inputs to generate one or more customizable disposition flowcharts 121 visually depicting the flow of estate components to beneficiaries and/or an estimate of the estate's future liquidity status 123.”

(Ex. 1005 [*Racanelli*] at [0029].)

99. *Racanelli* describes obtaining estate document inputs from wills, trusts, and other estate planning documents: “Estate document inputs may be retrieved from a variety of tangible or electronic records including, but not limited to, wills,

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codicils, revisions, amendments, revocable and irrevocable trusts, living trusts, assignments and other estate planning documents.” (Ex. 1005 [*Racanelli*] at [0048].)

“Generally, the estate document information reflects which assets are to be transferred to a particular survivor or beneficiary, and in what amount.” (Ex. 1005 [*Racanelli*] at [0043].)

100. *Racanelli* further describes analyzing the text of an estate planning document—such as a will—and using natural language processing (NLP) to generate estate document inputs that reflect who is transferring which assets to which recipients according to the estate planning document:

“[O]ne or more estate document inputs is retrieved electronically through, for example, natural language processing or reading fields or tags in an electronic estate document format. For example, an algorithm can analyze the text of the will (for example, parsing various instructions or conveyances within the will using templates or masks to recognize common language structures contained in wills such as ‘I [conveyor] leave my car [asset to be conveyed] to my nephew [heir (apparent) or intended beneficiary].’) to extract or approximate the conveyances contained therein.”

(Ex. 1005 [*Racanelli*] at [0048].)

101. Similar to *Racanelli*, *Bateman* describes a computer-implemented technique for analyzing documents such as wills to identify conveyances of interests

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in real property. (Ex. 1007 [*Bateman*] at [0051]-[0052], [0103]-[0109].) *Bateman* describes extracting from a document a plurality of “structured conveyance records” that may “identify a plot of land in which an interest is conveyed by the respective document, may identify a grantor of the conveyance, may identify a grantee of the conveyance, and/or may identify the interest conveyed.” (Ex. 1007 [*Bateman*] at [0108].) “In some cases a single document may yield several conveyance records, e.g., a grant of tenancy in common in a will to multiple heirs.” (Ex. 1007 [*Bateman*] at [0059].)

102. *Bateman* describes a machine-learning-with-human-review technique for extracting structured conveyance records from a document. *Bateman* first describes obtaining a document (such as a will) that has undergone optical character recognition. (Ex. 1007 [*Bateman*] at [0051]-[0052], [0105].) For example, *Bateman* describes performing OCR to recognize the text of a scanned will:

“Access component 116 may be configured to obtain one or more unstructured, machine-readable sets of data describing one or more conveyances of interest in real property. In some embodiments, the one or more sets of data may be a plurality of scanned documents. In some embodiments, the plurality of scanned documents may be optical-character-recognized (OCR) documents, each having OCR-produced English language text describing,

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in unstructured form, one or more conveyances of interest in real property.

In some cases, the documents may be multi-page printable document format (PDF) documents that depict legally operative conveyances of interests in real property. Examples include wills, leases, deeds, easements, deeds of trust, and the like.”

(Ex. 1007 [*Bateman*] at [0051]-[0052].)

103. *Bateman* further describes applying a language processing model to the document’s recognized text to identify conveyances and extract structured conveyance records. (Ex. 1007 [*Bateman*] at [0008], [0061]-[0074], [0108].)

104. *Bateman* describes training a language processing model “based on a combination of machine-learning algorithms and hand-coded rules.” (Ex. 1007 [*Bateman*] at [0072].) “For example, a training set for a language processing model may include features that are based on hand-coded rules and weights that are learned based on training data.” (Ex. 1007 [*Bateman*] at [0072].)

105. *Bateman* explains that the a language processing model’s machine-learning algorithm may be trained on unstructured text documents and corresponding structured conveyance records previously identified by a human: “A machine-learning algorithm, applied to a language processing model, may be trained, at least in part, on unstructured text documents and corresponding structured conveyance records (e.g., a collection of different instruments from a given

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jurisdiction and their corresponding runsheets as previously analyzed manually by a human reviewer).” (Ex. 1007 [*Bateman*] at [0070].)

106. *Bateman* explains that hand-coded rules can include “regular expressions (e.g., look for the text ‘hereby referred to as Grantor,’ extract the closest preceding proper noun, and designate the field ‘grantor’ as equal to the extracted value in a record for the instrument), nested if-then-else statements (e.g., decision trees), and/or other rules.” (Ex. 1007 [*Bateman*] at [0069].)

107. *Bateman* acknowledges, however, that natural language processing may not always successfully extract the correct value for a conveyance record parameter. For example, “[i]n some cases, natural language processing may be sufficient to extract, for example, four of eight parameters for a conveyance record, and other parameters may be supplied by a human reviewer.” (Ex. 1007 [*Bateman*] at [0071].) *Bateman* also acknowledges that “[i]n some cases, the extracted values may be incorrect, but even extracting values that are correct 40% of the time is expected to result in time savings for human reviewers, who often manually enter such values 100% of the time with traditional systems.” (Ex. 1007 [*Bateman*] at [0071].)

108. To improve the accuracy of the extracted structured conveyance records, *Bateman* provides a layer of human review with its language processing model. “In some cases, natural language processing may be sufficient to extract, for

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example, four of eight parameters for a conveyance record, and other parameters may be supplied by a human reviewer.” (Ex. 1007 [*Bateman*] at [0071].) To implement that human review, *Bateman* describes prompting the user to select from a set of candidate values identified and ranked by the language processing model:

“In some cases, extracting conveyance record parameters may include identifying a set of candidate values, ranking the candidate values according to likelihood of being the correct value as scored by the language processing model, and associating the ranking with the conveyance record, such that a human reviewer may select among the same.”

(Ex. 1007 [*Bateman*] at [0071].)

109. As an example of human review, *Bateman* describes prompting a human to select the correct name for a conveyor and the correct name for a conveyee from a list of candidate names for each role, receiving those selections, and applying the selections to the conveyance record:

“Some embodiments may, after identifying candidate names, identify candidate roles and then compare distances therebetween to select a conveyor name and a conveyee name. In cases where multiple candidate names are detected, some embodiments may associate the candidates with a corresponding conveyance record field, and a human reviewer may select among the candidates during human review. The received selection, upon

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receipt, may be applied to the corresponding conveyance record.”

(Ex. 1007 [*Bateman*] at [0067].)

110. *Bateman*’s technique can also track and identify conveyances of granular interests in real-property assets. (Ex. 1007 [*Bateman*] at [0048], [0108].) For example, *Bateman* describes tracking “air rights, water rights, wind rights, surface rights, beach access rights, easements, coal rights, and the like.” (Ex. 1007 [*Bateman*] at [0048].) Likewise, *Bateman*’s technique can track various types of mineral rights, “including mineral rights isolated among different depths, type of royalty (non-participating royalty interest, e.g., where the owner is entitled to a royalty and not a bonus), right to execute leases, right to receive bonuses, right to receive delay payments, etc.” (Ex. 1007 [*Bateman*] at [0048].) To track those granular interests, *Bateman* describes jurisdiction-specific “ontologies” that each provide default rules about real-property related rights in a particular jurisdiction:

“To track such rights, some embodiments may maintain in memory an ontology of real property related rights, including records of which rights are by default subsets of other rights unless explicitly reserved or conveyed. In some cases, different jurisdictions may be associated with different ontologies according to different default rules, and some embodiments may select a corresponding ontology according to the jurisdiction in which land is

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disposed in the course of performing analyses described herein.”

(Ex. 1007 [*Bateman*] at [0048].)

111. To determine the applicable jurisdiction, *Bateman* describes determining the jurisdiction of a plot of land (such as a county) based on parsing the document to identify the jurisdiction where the real property is located:

“In some embodiments, each (e.g., each, or each and every) document may be associated with metadata identifying a jurisdiction in which the respective real property is located. For instance, a collection of documents pertaining to a particular plot of land may be obtained from an external source, like a third party that scans and hosts content acquired from a county land office by the third party, and that third party may associate the collection of documents with metadata identifying the county land office. In other cases, the metadata may be acquired from the documents themselves, for instance, by parsing such documents, matching parsed tokens to names of counties stored in a dictionary of counties, and associating the document with the name of a detected county.”

(Ex. 1007 [*Bateman*] at [0055].)

112. Persons of ordinary skill in the art would have been motivated to provide *Racanelli*’s computing system with *Bateman*’s techniques for identifying

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conveyances of assets and interests in assets in documents such as wills and for generating structured data about those conveyances. To start, providing *Racanelli*'s computing system with *Bateman*'s techniques for identifying conveyances of assets and interests in assets in documents such as wills would have yielded more accurate and more granular results than *Racanelli*'s technique alone. While *Racanelli* describes using an NLP algorithm to identify a grantor/conveyor; a grantee/recipient; and an asset conveyed from the grantor/conveyor to the grantee/recipient, *Racanelli* does not expressly describe a human reviewing the NLP algorithm's work for accuracy. (Ex. 1005 [*Racanelli*] at [0048].) *Bateman*, however, acknowledges that NLP alone may not successfully identify every value of every parameter of a conveyance in a will—such as the name of the grantor or the recipient—or that values identified automatically may be incorrect. (Ex. 1007 [*Bateman*] at [0051]-[0052], [0071].) *Bateman* thus provides a machine-learning technique with a layer of human review so that a human can select the correct value for a conveyance's parameter—for example, the correct name of the grantor or recipient—thereby yielding more accurate results. (Ex. 1007 [*Bateman*] at [0067], [0071].) *Bateman*'s technique can also identify and track conveyances of interests in real-property assets such as mineral rights at a more granular level than *Racanelli* describes. (Ex. 1007 [*Bateman*] at [0048], [0108].)

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113. *Bateman*'s technique would have been an especially attractive option to persons of ordinary skill in the art because *Bateman* and *Racanelli* operate on the same inputs and produce substantially the same structured data. Both *Bateman*'s machine-learning-with-human-review technique and *Racanelli*'s NLP technique operate on the same inputs: the texts of wills and other documents that convey assets. (Ex. 1005 [*Racanelli*] at [0048]; Ex. 1007 [*Bateman*] at [0051]-[0052], [0108].) And both *Bateman*'s machine-learning-with-human-review technique and *Racanelli*'s NLP technique can produce substantially the same outputs: data that describes conveyances of assets from grantors to recipients. (Ex. 1005 [*Racanelli*] at [0038], [0048]; Ex. 1007 [*Bateman*] at [0108].) Because *Bateman*'s structured conveyance records are so similar to *Racanelli*'s estate document inputs, *Bateman*'s machine-learning-with-human-review technique for generating those structured conveyance records would have been well-suited for use in generating the estate document inputs *Racanelli* uses for its flowcharts. (Ex. 1005 [*Racanelli*] at [0029].)

Persons of ordinary skill in the art would have been motivated to provide Racanelli's computing system with Dintenfass's techniques for monitoring asset values in real-time and updating an estate planning visualization in real-time as asset values change.

114. As discussed, *Racanelli* describes a computing system that implements the techniques that *Racanelli* discloses: "Figure 15 is a schematic diagram of an exemplary computing system environment 1500 for use in implementing one or more of the disclosed embodiments. As understood by those of ordinary skill in the

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art, the various embodiments disclosed herein may be implemented by or include a computer or computers.” (Ex. 1005 [*Racanelli*] at [0070].)

115. As also discussed, *Racanelli* describes generating flowcharts to visualize a client’s estate plan. (Ex. 1005 [*Racanelli*] at [0029].) *Racanelli* further describes automatically updating those flowcharts based on changes in a client’s balance sheet: “Various embodiments also provide estate planners, wealth advisors and clients with customizable and annotatable flowcharts illustrating future dispositions of the estate that adjust automatically to changes in a client’s balance sheet and estate plan.” (Ex. 1005 [*Racanelli*] at [0085].)

116. *Dintenfass*, in turn, discloses an estate portal application that includes a user interface that displays the values of a user’s assets. (Ex. 1009 [*Dintenfass*] at [0062].) “In some embodiments this interface may illustrate information associated with the user assets (e.g., amount asset value, type of account, or the like) and/or the financial status of the beneficiaries.” (Ex. 1009 [*Dintenfass*] at [0062].)

117. *Dintenfass* further discloses updating the estate portal application’s display in real-time based on changes in asset values by continuously monitoring an electronic feed from a source of assets such as a financial institution. (Ex. 1009 [*Dintenfass*] at [0004]-[0006], [0049].) For example, *Dintenfass* describes a system that includes a software module “configured to continuously monitor the one or more sources of user assets; and update the asset value of the user assets associated with

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the one or more sources of user assets in real-time for display on the estate portal application.” (Ex. 1009 [*Dintenfass*] at [0006].) “In response to continuously monitoring the real-time data feeds, the system may be configured to update the asset value associated with the one or more sources of user assets and/or financial status of the beneficiaries in real-time for display on the estate portal application.” (Ex. 1009 [*Dintenfass*] at [0049].) *Dintenfass* thus teaches updating an estate planning visualization in real-time based on changes in the values of the estate’s assets.

118. Persons of ordinary skill in the art would have been motivated to provide *Racanelli*’s computing system with *Dintenfass*’s techniques for monitoring asset values in real-time and updating an estate planning visualization in real-time as asset values change. To start, combining the teachings of *Racanelli* and *Dintenfass* as I have described would have permitted a user (such as a client or estate planner) to make an informed decision on how to allocate the estate’s assets based on real-time, up-to-date asset values—for example, to reduce transaction costs or tax liability based on real-time, up-to-date asset values. (Ex. 1009 [*Dintenfass*] at [0049], [0054]; Ex. 1005 [*Racanelli*] at [0031].)

119. *Dintenfass* explains that a user may wish to transfer an asset while still alive based on transaction costs:

“In some embodiments, the system may be configured to determine the transaction cost implications of transferring assets immediately or after the user has passed away. As

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such, the system may determine if the user should transfer some assets immediately; however, alternatively, the desired transfer of assets may be saved and stored for when the user passes away.”

(Ex. 1009 [*Dintenfass*] at [0054].)

120. Similarly, *Racanelli* describes estimating the tax liability for a particular conveyance and identifying alternative conveyances that incur less tax liability, such as transferring an asset while the client is still alive via a living trust:

“For example, based on the estimated component tax liability of a particular conveyance 131, the system may generate possible alternative conveyances (for example, bequeathing an asset to a different beneficiary or establishing a living trust to hold particular assets). A differential of resultant estate tax liability may be estimated for the various alternatives and compared to the current or base scenario. Based on this comparison involving various if-then calculations, a recommendation of one or more of the gifting alternatives may be generated. Alternatively or in combination, the benefits and disadvantages of each of the evaluated alternatives in view of the current conveyance may be displayed to the user or estate planner.”

(Ex. 1005 [*Racanelli*] at [0031].)

121. Updating *Racanelli*’s flowcharts in real-time based on changes in asset values as taught by *Dintenfass* would have given the user the most up-to-date

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information to make an informed decision on how to transfer assets to reduce transaction costs and tax liability. It also would have ensured that a client deciding to transfer an asset while the client is still alive would know in real-time just how much the client could transfer—thereby avoiding, for example, the client bouncing a gift check based on an out-of-date value of the client's checking account.

122. Finally, combining the teachings of *Racanelli* and *Dintenfass* as I have described would have applied a known technique (*Dintenfass*'s real-time asset value monitoring and real-time updates to an estate planning visualization based on asset value changes) to a known device, method, or product ready for improvement (*Racanelli*'s estate-planning visualizations) to yield predictable results (updating *Racanelli*'s estate-planning visualizations in real time based on changes in asset values monitored according to the teachings of *Dintenfass*).

iii. Persons of ordinary skill in the art would have had a reasonable expectation of success in combining the teachings of *Racanelli*, *Bateman*, and *Dintenfass*.

123. The combination of *Racanelli*, *Bateman*, and *Dintenfass* that I have discussed would have entailed adding, to *Racanelli*'s computing system, (1) programming to implement *Bateman*'s techniques for identifying conveyances of assets and interests in assets in documents such as wills and for generating structured data about those conveyances; and (2) programming to implement *Dintenfass*'s techniques for monitoring asset values in real-time and updating an estate planning

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visualization in real-time as asset values change. Adding that programming to *Racanelli*'s computing system would have required only routine programming knowledge well within the skill of persons of ordinary skill in the art as of November 29, 2023. For that reason, persons of ordinary skill in the art would have had a reasonable expectation of successfully combining the teachings of *Racanelli*, *Bateman*, and *Dintenfass*.

2. Claim 1

i. 1[p]: A computer-implemented method comprising:

124. *Racanelli* discloses a computer-implemented method.

125. *Racanelli* states that “[v]arious disclosed embodiments are generally directed to a system and computer-implemented method of modeling estate disposition.” (Ex. 1005 [*Racanelli*] at [0028].) *Racanelli* further explains that “the various embodiments disclosed herein may be implemented by or include a computer or computers.” (Ex. 1005 [*Racanelli*] at [0070].)

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- ii. **1[a]: generating, by a computing system comprising one or more processors, based on inputting one or more resource documents into one or more machine-learning models, one or more prompts comprising requests for information associated with resource allocation instructions for distribution of resources, wherein the one or more machine-learning models are configured to generate the one or more prompts based on recognition of textual features of the one or more resource documents associated with the resources, wherein the one or more resource documents comprise one or more resource document fields, and wherein the resource allocation instructions are associated with distribution of one or more assets of the resources to one or more entities comprising one or more resource recipients;**

126. *Racanelli* in view of *Bateman* renders obvious generating, by a computing system comprising one or more processors, based on inputting one or more resource documents into one or more machine-learning models, one or more prompts comprising requests for information associated with resource allocation instructions for distribution of resources, wherein the one or more machine-learning models are configured to generate the one or more prompts based on recognition of textual features of the one or more resource documents associated with the resources, wherein the one or more resource documents comprise one or more resource document fields, and wherein the resource allocation instructions are associated with distribution of one or more assets of the resources to one or more entities comprising one or more resource recipients.

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127. To start, *Racanelli* discloses a computing system comprising one or more processors. *Racanelli* describes a computing system that implements the techniques that *Racanelli* discloses: “Figure 15 is a schematic diagram of an exemplary computing system environment 1500 for use in implementing one or more of the disclosed embodiments. As understood by those of ordinary skill in the art, the various embodiments disclosed herein may be implemented by or include a computer or computers.” (Ex. 1005 [*Racanelli*] at [0070].)

128. *Racanelli* further discloses that the computing system has a processor: “The computer system may include a general purpose computing device in the form of a computer 1501 including a processing unit 1503, a system memory 1505, and a system bus 1507 that couples various system components including the system memory to the processing unit.” (Ex. 1005 [*Racanelli*] at [0072].)

129. *Racanelli* discloses one or more resource documents. The ’917 Patent explains that wills and trusts are examples of resource documents associated with resources. (Ex. 1001 [’917 Patent] at 5:3-11, 7:38-46, Claim 12.) *Racanelli* discloses wills and trusts: “Estate document inputs may be retrieved from a variety of tangible or electronic records including, but not limited to, wills, codicils, revisions, amendments, revocable and irrevocable trusts, living trusts, assignments and other estate planning documents.” (Ex. 1005 [*Racanelli*] at [0048].) As

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Racanelli's wills and trusts are examples of resource documents, *Racanelli* discloses one or more resource documents.

130. *Racanelli* discloses that its one or more resource documents include one or more resource document fields. The '917 Patent explains that "resource document fields can be associated with one or more entities and/or one or more assets." (Ex. 1001 ['917 Patent] at 7:48-50.) *Racanelli* describes an example of a will with resource document fields corresponding to a testator (entity), an asset (a car), and a recipient (entity):

"[O]ne or more estate document inputs is retrieved electronically through, for example, natural language processing or reading fields or tags in an electronic estate document format. For example, an algorithm can analyze the text of the will (for example, parsing various instructions or conveyances within the will using templates or masks to recognize common language structures contained in wills such as 'I [conveyor] leave my car [asset to be conveyed] to my nephew [heir (apparent) or intended beneficiary].') to extract or approximate the conveyances contained therein."

(Ex. 1005 [*Racanelli*] at [0048].)

131. *Racanelli* further discloses resource allocation instructions for distribution of resources, which resource allocation instructions are associated with distribution of one or more assets of the resources to one or more entities comprising

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one or more recipients. As one example, *Racanelli* describes a will that includes “instructions or conveyances” that prescribe how resources should be allocated to recipients—for example, allocating a car (asset of the resources) to an heir (entity comprising one or more recipients):

“For example, an algorithm can analyze the text of the will (for example, parsing various instructions or conveyances within the will using templates or masks to recognize common language structures contained in wills such as ‘I [conveyor] leave my car [asset to be conveyed] to my nephew [heir (apparent) or intended beneficiary].’) to extract or approximate the conveyances contained therein.”

(Ex. 1005 [*Racanelli*] at [0048].)

132. *Racanelli* also describes a specific bequest (instruction to allocate/distribute a specific asset) to a spouse (recipient): “For each decedent, various pre-residuary specific bequests may be identified and input 417. Optionally, a change in name of listed category will flow through to the disposition output. In the illustrated example, the bequest to ‘Spouse 2’ denotes a specific bequest to the client’s spouse.” (Ex. 1005 [*Racanelli*] at [0045].) *Racanelli* further discloses other examples of resources and assets that may be distributed or allocated to recipients, such as cash, securities, and real property. (Ex. 1005 [*Racanelli*] at [0035]-[0036].)

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133. Turning to *Bateman*, *Bateman* discloses the claimed “generating . . . based on inputting one or more resource documents into one or more machine-learning models, one or more prompts comprising requests for information associated with resource allocation instructions for distribution of resources, wherein the one or more machine-learning models are configured to generate the one or more prompts based on recognition of textual features of the one or more resource documents associated with the resources, wherein the one or more resource documents comprise one or more resource document fields, and wherein the resource allocation instructions are associated with distribution of one or more assets of the resources to one or more entities comprising one or more resource recipients.”

134. To start, *Bateman* discloses both (1) a resource document; and (2) recognizing textual features of the resource document. For example, *Bateman* discloses recognizing the text of a will using optical character recognition:

“Access component 116 may be configured to obtain one or more unstructured, machine-readable sets of data describing one or more conveyances of interest in real property. In some embodiments, the one or more sets of data may be a plurality of scanned documents. In some embodiments, the plurality of scanned documents may be optical-character-recognized (OCR) documents, each having OCR-produced English language text describing,

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in unstructured form, one or more conveyances of interest in real property.

In some cases, the documents may be multi-page printable document format (PDF) documents that depict legally operative conveyances of interests in real property. Examples include wills, leases, deeds, easements, deeds of trust, and the like.”

(Ex. 1007 [*Bateman*] at [0051]-[0052].)

* * *

“At an operation 708, a plurality of structured conveyance records may be extracted for each of the documents from the respective OCR-produced English language text describing, in unstructured form, one or more conveyances of interest in real property.”

(Ex. 1007 [*Bateman*] at [0108].)

135. Like *Racanelli*, *Bateman* discloses a resource document, such as a will, that includes one or more resource document fields. *Bateman* describes that the documents on which it operates, such as wills, “depict legally operative conveyances of interests in real property.” (Ex. 1007 [*Bateman*] at [0052].) *Bateman* further discloses that those documents include resource document fields identifying, among other features, a grantor, a grantee, and the asset being conveyed:

“In some cases, such documents may include text defining parties, such as prose describing a ‘grantor’ conveying an interest (e.g., ‘John Doe (hereinafter ‘Seller’); prose

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describing a grantee (e.g., ‘Mary Smith (hereinafter ‘Buyer’)’); prose describing a date of conveyance (e.g., ‘effective Mar. 23, 2001’); prose describing what is being conveyed, like an interest in land (e.g., a fee simple, leasehold, mineral rights, easement, etc.); and prose describing the land at issue (e.g., the metes and bounds, lot number, or latitude and longitude coordinates of vertices of a bounding polygon).”

(Ex. 1007 [*Bateman*] at [0052] (underlining added).)

136. Like *Racanelli*, *Bateman* also discloses resource allocation instructions are associated with distribution of one or more assets of the resources to one or more entities comprising one or more resource recipients. (Ex. 1007 [*Bateman*] at [0051]-[0052], [0108].) For example, *Bateman* describes documents that include “legally operative conveyances of interests in real property,” such as wills. (Ex. 1007 [*Bateman*] at [0052].) Those “legally operative conveyances of interests in real property” are resource allocation instructions in that they distribute an interest in real property (asset of the resources) to a grantee (one or more entities comprising one or more resource recipients), as *Bateman* explains:

“In some cases, such documents may include text defining parties, such as prose describing a ‘grantor’ conveying an interest (e.g., ‘John Doe (hereinafter ‘Seller’)’); prose describing a grantee (e.g., ‘Mary Smith (hereinafter ‘Buyer’)’); prose describing a date of conveyance (e.g.,

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‘effective Mar. 23, 2001’); prose describing what is being conveyed, like an interest in land (e.g., a fee simple, leasehold, mineral rights, easement, etc.); and prose describing the land at issue (e.g., the metes and bounds, lot number, or latitude and longitude coordinates of vertices of a bounding polygon).”

(Ex. 1007 [*Bateman*] at [0052].)

137. *Bateman* discloses a machine-learning model. (Ex. 1007 [*Bateman*] at [0070]-[0073].) For example, *Bateman* describes a language processing model trained by machine-learning algorithms and hand-coded rules:

“In some embodiments, the one or more language processing models may include a language processing model trained by machine-learning algorithms. A machine-learning algorithm, applied to a language processing model, may be trained, at least in part, on unstructured text documents and corresponding structured conveyance records (e.g., a collection of different instruments from a given jurisdiction and their corresponding runsheets as previously analyzed manually by a human reviewer).”

(Ex. 1007 [*Bateman*] at [0070].)

“In some embodiments, training a given language processing model may be based on a combination of machine-learning algorithms and hand-coded rules.”

(Ex. 1007 [*Bateman*] at [0072].)

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138. *Bateman* discloses inputting a will or other document reflecting legally operative conveyances of interests in property (resource document) into the language processing model (machine-learning model). (Ex. 1007 [*Bateman*] at [0061], [0063], [0066], [0070]-[0072], [0074]-[0075], [0108].) For example, *Bateman* describes applying a language processing model to the text of a document: “The one or more language processing models may take as input the text of a given document and extract parameters of conveyance records.” (Ex. 1007 [*Bateman*] at [0063].) *Bateman* further describes obtaining the text of the document via optical character recognition. (Ex. 1007 [*Bateman*] at [0051]-[0052], [0074], [0108].)

139. *Bateman*’s language processing model generates one or more prompts comprising requests for information associated with resource allocation instructions for distribution of resources, which prompts are generated based on recognition of textual features of the one or more resource documents associated with the resources. As discussed, *Bateman* describes recognizing text in resource documents such as wills using optical character recognition, and its language processing model extracts structured conveyance records from the document’s text. (Ex. 1007 [*Bateman*] at [0051]-[0052], [0063], [0066], [0074]-[0075], [0108].) As part of that process, the language processing model can identify candidate values for a parameter of a conveyance record and prompt a human reviewer to select the correct value:

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“Extracting conveyance records may include extracting only some parameters of such records and extracting likely candidate values for such parameters. In some cases, natural language processing may be sufficient to extract, for example, four of eight parameters of a conveyance record, and other parameters may be supplied by a human reviewer. In some cases, extracting conveyance record parameters may include identifying a set of candidate values, ranking the candidate values according to likelihood of being the correct value as scored by the language processing model, and associating the ranking with the conveyance record, such that a human reviewer may select among the same.”

(Ex. 1007 [*Bateman*] at [0071].)

140. For example, *Bateman*’s language processing model can identify candidate names for the grantor of an asset and the grantee of the asset, and prompt a human reviewer to select the correct names for the grantor and the grantee:

“Some embodiments may, after identifying candidate names, identify candidate roles and then compare distances therebetween to select a conveyor name and a conveyee name. In cases where multiple candidate names are detected, some embodiments may associate the candidates with a corresponding conveyance record field,

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and a human reviewer may select among the candidates during human review.”

(Ex. 1007 [*Bateman*] at [0067].)

141. The '917 Patent explains that a prompt can be a question “configured to receive one or more prompt response types,” such as “selecting from a list of responses.” (Ex. 1001 ['917 Patent] at 6:26-32.) Thus, generating a list of candidate values from which a human can make a selection as *Bateman* describes is an example of generating a prompt. *Bateman*'s prompts to a human reviewer to select from a list of candidate values for a parameter of a conveyance in a will (or other document) are also “requests for information associated with resource allocation instructions for distribution of resources” in that they can include requests for information about who is conveying an asset, who is receiving an asset, what is being conveyed, and other conveyance parameters. (Ex. 1007 [*Bateman*] at [0067], [0071].)

142. As discussed above in **Section XII.B.1.ii**, persons of ordinary skill in the art would have been motivated to provide *Racanelli*'s computing system with *Bateman*'s technique for identifying conveyances of assets and interests in assets in wills, which includes inputting a will's text into a language processing model and generating a prompt for a human reviewer to select a value for a conveyance record parameter from a set of candidate values determined from the text of the document. (Ex. 1007 [*Bateman*] at [0067], [0071].) I adopt that analysis here as well.

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143. *Racanelli* in view of *Bateman* therefore renders obvious generating, by a computing system comprising one or more processors, based on inputting one or more resource documents into one or more machine-learning models, one or more prompts comprising requests for information associated with resource allocation instructions for distribution of resources, wherein the one or more machine-learning models are configured to generate the one or more prompts based on recognition of textual features of the one or more resource documents associated with the resources, wherein the one or more resource documents comprise one or more resource document fields, and wherein the resource allocation instructions are associated with distribution of one or more assets of the resources to one or more entities comprising one or more resource recipients.

iii. 1[b]: receiving, by the computing system, one or more responses to the one or more prompts;

144. *Racanelli* in view of *Bateman* renders obvious receiving, by the computing system, one or more responses to the one or more prompts.

145. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses the claimed computing system, and *Racanelli* in view of *Bateman* renders obvious the claimed “one or more prompts.” In particular, *Bateman* teaches prompting a human reviewer to select a candidate value from a list of candidate values for a conveyance record parameter, such as candidate names for a grantor or grantee. (Ex. 1005 [*Bateman*] at [0067], [0071].) I adopt that analysis here as well.

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146. *Bateman* further discloses receiving a human's selection of a candidate value from the list of candidate values for a conveyance record parameter. (Ex. 1007 [*Bateman*] at [0067], [0071].) For example, *Bateman* discloses receiving a human's selection of a candidate name for a conveyor or a conveyee:

“Some embodiments may, after identifying candidate names, identify candidate roles and then compare distances therebetween to select a conveyor name and a conveyee name. In cases where multiple candidate names are detected, some embodiments may associate the candidates with a corresponding conveyance record field, and a human reviewer may select among the candidates during human review. The received selection, upon receipt, may be applied to the corresponding conveyance record.”

(Ex. 1007 [*Bateman*] at [0067] (underlining added).)

147. The human reviewer's selection of the candidate value is a response to the prompt to select a candidate value from the list of candidate values. (Ex. 1007 [*Bateman*] at [0067], [0071].) Thus, *Bateman* teaches receiving one or more responses to the one or more prompts.

148. As discussed above in **Section XII.B.1.ii**, persons of ordinary skill in the art would have been motivated to provide *Racanelli*'s computing system with *Bateman*'s technique for identifying conveyances of assets and interests in assets in wills, which includes receiving a human's selection of a value from a set of candidate

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values for a conveyance record parameter. (Ex. 1007 [*Bateman*] at [0067], [0071].)

I adopt that analysis here as well. *Racanelli* in view of *Bateman* therefore renders obvious receiving, by the computing system, one or more responses to the one or more prompts.

- iv. **1[c]: generating, by the computing system, based on inputting the one or more responses and rule data comprising one or more rules associated with the resources into the one or more machine-learning models, resource data comprising one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields, wherein the one or more machine-learning models are trained based on training data comprising training resource data and training rule data, and wherein the one or more resource data fields are based on the one or more resource document fields, and wherein the one or more resource data field values are based on the one or more responses;**

149. *Racanelli* in view of *Bateman* renders obvious generating, by the computing system, based on inputting the one or more responses and rule data comprising one or more rules associated with the resources into the one or more machine-learning models, resource data comprising one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields, wherein the one or more machine-learning models are trained based on training data comprising training resource data and training rule data, and wherein the one or more resource data fields are based on the one or more resource

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document fields, and wherein the one or more resource data field values are based on the one or more responses.

150. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses the claimed computing system, and *Racanelli* in view of *Bateman* renders obvious the claimed one or more machine-learning models and the claimed resource document fields. I adopt that analysis here as well.

151. As discussed above for Claim 1[b] in **Section XII.B.2.iii**, *Racanelli* in view of *Bateman* renders obvious the claimed “one or more responses.” I adopt that analysis here as well.

152. I will address Claim 1[c]’s features in three parts:

Part 1: I will discuss *Bateman*’s disclosure of generating resource data “based on inputting the one or more responses and rule data comprising one or more rules associated with the resources into the one or more machine-learning models.”

Part 2: I will discuss *Bateman*’s disclosure of the generated “resource data” comprising “one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields . . . and wherein the one or more resource data fields are based on the one or more resource document fields, and wherein the one or more resource data field values are based on the one or more responses.”

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Part 3: I will discuss *Bateman*'s disclosure of the one or more machine-learning models being "trained based on training data comprising training resource data and training rule data."

153. **Part 1:** *Bateman* discloses generating resource data based on inputting the one or more responses and rule data comprising one or more rules associated with the resources into the one or more machine-learning models, resource data.

154. *Bateman* discloses that one or more responses are input into its language processing model (machine-learning model). *Bateman* discloses that its language processing model permits the selection of inputs during its extraction of structured conveyance records:

"The one or more language processing models may be configured to automatically (which is not to imply that other steps herein are not automatic, or that manual steps may not be interspersed with the extraction, e.g., to clear errors, select inputs, etc.) extract structured information from the one or more unstructured, machine-readable sets of data."

(Ex. 1007 [*Bateman*] at [0061].)

155. One of the inputs that *Bateman* describes is a human selecting a value for a parameter of a conveyance record from a set of candidate values. (Ex. 1007 [*Bateman*] at [0067], [0071].) As discussed above for Claim 1[b] in **Section XII.B.2.iii**, that selection of a value for a parameter of a conveyance record is a

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“response” to a prompt as claimed. I adopt that analysis here as well. Confirming that the selection of the value for the parameter of a conveyance record (response) is input into *Bateman*’s language processing model, *Bateman* describes receiving the selection and applying it to the structured conveyance record that its language processing model generates:

“Some embodiments may, after identifying candidate names, identify candidate roles and then compare distances therebetween to select a conveyor name and a conveyee name. In cases where multiple candidate names are detected, some embodiments may associate the candidates with a corresponding conveyance record field, and a human reviewer may select among the candidates during human review. The received selection, upon receipt, may be applied to the corresponding conveyance record.”

(Ex. 1007 [*Bateman*] at [0067] (underlining added).)

156. Thus, *Bateman* discloses inputting a selection of a value for a parameter of a conveyance record (response) into its language processing model (machine-learning model).

157. *Bateman* further discloses that rule data comprising one or more rules associated with the resources is input into its language processing model (machine-learning model). *Bateman* discloses that feature in three separate ways.

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158. *First*, the '917 Patent explains that such “rule data” can include provisions of a will: “Further, the one or more rules can be based on one or more provisions of the one or more resource documents (e.g., network policy documents, estate documents, an estate plan, provisions of a will, trust, healthcare directive, power of attorney, and/or insurance policy).” (Ex. 1001 ['917 Patent] at 8:41-45.) *Bateman* discloses inputting a will, including provisions of the will associated with conveying property, into *Bateman*’s language processing model:

“In some cases, the documents may be multi-page printable document format (PDF) documents that depict legally operative conveyances of interests in real property. Examples include wills, leases, deeds, easements, deeds of trust, and the like. In some cases, such documents may include text defining parties, such as prose describing a “grantor” conveying an interest (e.g., “John Doe (hereinafter ‘Seller’)”; prose describing a grantee (e.g., “Mary Smith (hereinafter ‘Buyer’)”); prose describing a date of conveyance (e.g., “effective Mar. 23, 2001”); prose describing what is being conveyed, like an interest in land (e.g., a fee simple, leasehold, mineral rights, easement, etc.); and prose describing the land at issue (e.g., the metes and bounds, lot number, or latitude and longitude coordinates of vertices of a bounding polygon).”

(Ex. 1007 [*Bateman*] at [0052] (underlining added).)

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“The one or more language processing models may take as input the text of a given document and extract parameters of conveyance records.”

(Ex. 1007 [*Bateman*] at [0063].)

159. *Second*, *Bateman* describes inputting into its language processing model a jurisdiction-specific ontology that identifies types and subsets of interests in real property that can be conveyed, which are rules associated with real-property resources. (Ex. 1007 [*Bateman*] at [0048].) *Bateman* explains that “some embodiments may select a corresponding ontology according to the jurisdiction in which land is disposed in the course of performing analyses described herein.” (Ex. 1007 [*Bateman*] at [0048].) Those analyses are performed using *Bateman*’s language processing model, which is a machine-learning model as discussed. (Ex. 1007 [*Bateman*] at [0070], [0072].) Persons of ordinary skill in the art would have recognized that “select[ing] a corresponding ontology according to the jurisdiction in which land is disposed in the course of performing analyses described herein” would have involved inputting the corresponding ontology into *Bateman*’s language processing model so that the language processing model could use that ontology.

160. *Third*, *Bateman* discloses inputting hand-coded rules for identifying conveyances into its language processing model in order to train the language processing model, which are rules associated with resources in that they are used to identify conveyances of real-property resources:

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“In some embodiments, the language processing models may include a language processing model based, at least in part, on hand-coded rules. Examples of such rules may include regular expressions (e.g., look for the text ‘hereby referred to as Grantor,’ extract the closest preceding proper noun, and designate the field ‘grantor’ as equal to the extracted value in a record for the instrument), nested if-then-else statements (e.g., decision trees), and/or other rules.”

(Ex. 1007 [*Bateman*] at [0069].)

* * *

“In some embodiments, training a given language processing model may be based on a combination of machine-learning algorithms and hand-coded rules. For example, a training set for a language processing model may include features that are based on hand-coded rules and weights that are learned based on training data. Combining machine-learning algorithms and hand-coded rules is described in Michael Curtotti and Eric McCreath, Corpus Based Classification of Text in Australian Contracts, Proceedings of Australasian Language Technology Association Workshop, 18-26 (2010), <http://www.aclweb.org/anthology/U10-1005>, which is incorporated by reference in its entirety.”

(Ex. 1007 [*Bateman*] at [0072] (underlining added).)

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161. *Bateman* further discloses generating structured conveyance records based on the input responses and rule data. Starting with the input responses, *Bateman* describes that a human reviewer may select from a list of candidate values for a particular parameter of a structured conveyance record, and that the selected candidate value is applied to the conveyance record's parameter, such that the parameter's value in the structured conveyance record is based on the selected candidate value (input response). (Ex. 1007 [*Bateman*] at [0067], [0071].)

162. In a specific example, *Bateman* describes receiving a user's selections of the conveyor's name and the conveyee's name and applying those selections to corresponding fields in the structured conveyance record:

“Some embodiments may, after identifying candidate names, identify candidate roles and then compare distances therebetween to select a conveyor name and a conveyee name. In cases where multiple candidate names are detected, some embodiments may associate the candidates with a corresponding conveyance record field, and a human reviewer may select among the candidates during human review. The received selection, upon receipt, may be applied to the corresponding conveyance record.”

(Ex. 1007 [*Bateman*] at [0067] (underlining added).)

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163. As for rule data, *Bateman* discloses generating its structured conveyance records based on all three examples of input rule data I have discussed: provisions of a will, jurisdiction-specific ontologies, and hand-coded rules.

164. *First*, *Bateman* discloses that its structured conveyance records are generated based on provisions of a will input into its language processing model:

“In some cases, the documents may be multi-page printable document format (PDF) documents that depict legally operative conveyances of interests in real property. Examples include wills, leases, deeds, easements, deeds of trust, and the like. In some cases, such documents may include text defining parties, such as prose describing a “grantor” conveying an interest (e.g., “John Doe (hereinafter ‘Seller’)”; prose describing a grantee (e.g., “Mary Smith (hereinafter ‘Buyer’)”); prose describing a date of conveyance (e.g., “effective Mar. 23, 2001”); prose describing what is being conveyed, like an interest in land (e.g., a fee simple, leasehold, mineral rights, easement, etc.); and prose describing the land at issue (e.g., the metes and bounds, lot number, or latitude and longitude coordinates of vertices of a bounding polygon).”

(Ex. 1007 [*Bateman*] at [0052] (underlining added).)

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“The one or more language processing models may take as input the text of a given document and extract parameters of conveyance records.”

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(Ex. 1007 [*Bateman*] at [0063].)

165. *Second*, *Bateman* discloses that its structured conveyance records are generated based on the jurisdiction-specific ontologies accessed by its language processing model. In particular, *Bateman* describes tracking conveyances of interests in real property based on a jurisdiction-specific ontology:

“For example, embodiments may track real estate generally (e.g., fee simple titles), air rights, water rights, wind rights, surface rights, beach access rights, easements, coal rights, and the like. Mineral rights may be tracked at the level of components, including mineral rights isolated among different depths, type of royalty (non-participating royalty interest, e.g., where the owner is entitled to a royalty and not a bonus), right to execute leases, right to receive bonuses, right to receive delay payments, etc. To track such rights, some embodiments may maintain in memory an ontology of real property related rights, including records of which rights are by default subsets of other rights unless explicitly reserved or conveyed. In some cases, different jurisdictions may be associated with different ontologies according to different default rules, and some embodiments may select a corresponding ontology according to the jurisdiction in which land is disposed in the course of performing analyses described herein.”

(Ex. 1007 [*Bateman*] at [0048].)

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166. As *Bateman* describes generating structured conveyance records to track conveyances of interests in real property, persons of ordinary skill in the art would have understood that *Bateman*'s structured conveyance records are generated based on a jurisdiction-specific ontology. (Ex. 1007 [*Bateman*] at [0074], [0108].)

167. *Third*, *Bateman* discloses that its structured conveyance records are generated based on input hand-coded rules. In particular, *Bateman* describes training the language processing model that generates those structured conveyance records on hand-coded rules. (Ex. 1007 [*Bateman*] at [0069], [0072].) Training a language processing model on those hand-coded rules would have involved inputting those rules into the language processing model. And because the language processing model is trained on those input hand-coded rules, the language processing model's output—the structured conveyance records—is based on those input rules.

168. Finally, the structured conveyance records that *Bateman* generates constitute “resource data” as described and claimed in the '917 Patent. One example of “resource data” that the '917 Patent describes is data reflecting which recipients receive which assets:

“For example, based on resource data that indicates the specific assets (e.g., computing devices, documents, houses, vehicles, securities, and/or cash) to be distributed to various resource recipients, the computing system can generate visualizations that indicate which resource

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recipients receive which assets and the amounts of the assets that each of the resource recipients receives.”

(Ex. 1001 [’917 Patent] at 5:45-52.)

169. *Bateman*’s structured conveyance records likewise reflect which recipients receive which assets. For example, *Bateman* describes that “each extracted conveyance record identifies one or more of a plot of land in which an interest is conveyed by the respective document, a grantor of the conveyance, a grantee of the conveyance, or the interest conveyed, and/or identifies other interest-related information of the real property.” (Ex. 1007 [*Bateman*] at [0074].) Likewise, “[e]ach extracted conveyance record may identify a plot of land in which an interest is conveyed by the respective document, may identify a grantor of the conveyance, may identify a grantee of the conveyance, and/or may identify the interest conveyed.” (Ex. 1007 [*Bateman*] at [0108].) And Claim 1 of *Bateman* describes that “each extracted conveyance record identifies land in which an interest is conveyed by the respective document, identifies a grantor of the conveyance, identifies a grantee of the conveyance, and identifies the interest conveyed.” (Ex. 1007 [*Bateman*] at Claim 1.) Thus, *Bateman* discloses resource data.

170. **Part 2:** *Bateman* discloses that the generated “resource data”—its structured conveyance records—comprises “one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields . . . and wherein the one or more resource data fields are based on the one

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or more resource document fields, and wherein the one or more resource data field values are based on the one or more responses.”

171. *Bateman* explains that its structured conveyance records include fields whose values identify the grantor, grantee, and asset conveyed—*i.e.*, resource data fields. For example, “each extracted conveyance record identifies one or more of a plot of land in which an interest is conveyed by the respective document, a grantor of the conveyance, a grantee of the conveyance, or the interest conveyed, and/or identifies other interest-related information of the real property.” (Ex. 1007 [*Bateman*] at [0074].) Likewise, “[e]ach extracted conveyance record may identify a plot of land in which an interest is conveyed by the respective document, may identify a grantor of the conveyance, may identify a grantee of the conveyance, and/or may identify the interest conveyed.” (Ex. 1007 [*Bateman*] at [0108].) Further, Claim 1 of *Bateman* describes that “each extracted conveyance record identifies land in which an interest is conveyed by the respective document, identifies a grantor of the conveyance, identifies a grantee of the conveyance, and identifies the interest conveyed.” (Ex. 1007 [*Bateman*] at Claim 1.)

172. Those resource data fields for the conveyee, conveyor, and asset conveyed correspond to the resource document fields in wills that identify a grantor, grantee, and the asset being conveyed:

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“In some cases, the documents may be multi-page printable document format (PDF) documents that depict legally operative conveyances of interests in real property. Examples include wills, leases, deeds, easements, deeds of trust, and the like. In some cases, such documents may include text defining parties, such as prose describing a “grantor” conveying an interest (e.g., “John Doe (hereinafter ‘Seller’)”; prose describing a grantee (e.g., “Mary Smith (hereinafter ‘Buyer’)”); prose describing a date of conveyance (e.g., “effective Mar. 23, 2001”); prose describing what is being conveyed, like an interest in land (e.g., a fee simple, leasehold, mineral rights, easement, etc.); and prose describing the land at issue (e.g., the metes and bounds, lot number, or latitude and longitude coordinates of vertices of a bounding polygon).”

(Ex. 1007 [*Bateman*] at [0052] (underlining added).)

173. *Bateman* further discloses basing a value of the resource data fields in its structured conveyance records on a response to a prompt. For example, *Bateman* describes that a human reviewer may select from a list of candidate values for a particular parameter (field) of a structured conveyance record, and that the selected candidate value (response) is applied to the conveyance record’s parameter, such that the parameter’s value in the structured conveyance record (resource data field value) is based on the selected candidate value (response to a prompt). (Ex. 1007 [*Bateman*] at [0067], [0071].)

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174. In a specific example, *Bateman* describes receiving a user's selections of the conveyor's name and the conveyee's name and applying those selections to corresponding fields in the structured conveyance record:

“Some embodiments may, after identifying candidate names, identify candidate roles and then compare distances therebetween to select a conveyor name and a conveyee name. In cases where multiple candidate names are detected, some embodiments may associate the candidates with a corresponding conveyance record field, and a human reviewer may select among the candidates during human review. The received selection, upon receipt, may be applied to the corresponding conveyance record.”

(Ex. 1007 [*Bateman*] at [0067] (underlining added).)

175. Thus far, I have discussed how *Bateman*'s language processing model generates structured conveyance records (resource data) based on a user's selection of the correct value of a conveyance record's parameter (one or more responses) and provisions of a will (rule data associated with resources), a jurisdiction-specific ontology (another example of rule data associated with resources), and hand-coded rules for identifying conveyances (another example of rule data associated with resources). I have also discussed how *Bateman*'s structured conveyance records (resource data) include fields for a grantor, recipient, and asset (resource data fields based on resource document fields), some or all of which have values supplied by a

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human reviewer (resource data fields based on one or more responses). I will turn in Part 3 to how *Bateman*'s language processing model is trained.

176. **Part 3:** *Bateman* discloses one or more machine-learning models “trained based on training data comprising training resource data and training rule data.” *Bateman* discloses that its language processing model (machine-learning model) is trained on training data that includes structured conveyance records (training resource data); provisions of wills (an example of training rule data); and hand-coded rules (another example of training rule data).

177. To start, *Bateman* discloses training its language processing model on structured conveyance records, which structured conveyance records constitute “resource data” for the reasons I have discussed in **Parts 1 and 2**. The structured conveyance records used to train *Bateman*'s language processing model are therefore “training resource data.” For example, *Bateman* describes training a language processing model on both documents and structured conveyance records generated from those documents as previously analyzed by a human:

“In some embodiments, the one or more language processing models may include a language processing model trained by machine-learning algorithms. A machine-learning algorithm, applied to a language processing model, may be trained, at least in part, on unstructured text documents and corresponding structured conveyance records (e.g., a collection of different

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instruments from a given jurisdiction and their corresponding runsheets as previously analyzed manually by a human reviewer).”

(Ex. 1007 [*Bateman*] at [0070].)

178. Claims 5 and 7 of *Bateman* also describe training a language processing model (machine-learning model) on structured conveyance records (training resource data). Claim 5 describes “obtaining, with one or more processors, a training set of conveyance records and documents from which the conveyance records were manually populated; and training, with one or more processors, at least in part, a language processing model based on the training set.” (Ex. 1007 [*Bateman*] at Claim 5.) Claim 7 describes “wherein the one or more language processing models comprise a language processing model trained on a training set of conveyance records and documents from which the conveyance records were extracted.” (Ex. 1007 [*Bateman*] at Claim 7.)

179. *Bateman* therefore discloses that its language processing model (machine-learning model) is trained on training structured conveyance records (training data comprising training resource data).

180. *Bateman* discloses that its language processing model is also trained on training data comprising training rule data. *Bateman* discloses two examples of training data comprising training rule data for its language processing model.

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181. As a first example of *Bateman*'s language processing model being trained on training rule data, *Bateman* discloses training its language processing model on wills that include provisions for conveying property. In particular, *Bateman* describes training its language processing model on unstructured text documents. (Ex. 1007 [*Bateman*] at [0070].) *Bateman* further describes a will as an example of an unstructured text document that includes provisions that convey legally operative conveyances of interests in real property. (Ex. 1007 [*Bateman*] at [0051]-[0052].) Thus, *Bateman* describes training its language processing model on wills that include provisions that convey legally operative conveyances of interests in real property. The '917 Patent describes provisions of wills as an example of rule data, so provisions of wills used to train a machine-learning model as described in *Bateman* constitute training rule data. (Ex. 1001 ['917 Patent] at 8:41-45.)

182. As a second example of *Bateman*'s language processing model being trained on training rule data, *Bateman* discloses training its language processing model on hand-coded rules: "In some embodiments, training a given language processing model may be based on a combination of machine-learning algorithms and hand-coded rules. For example, a training set for a language processing model may include features that are based on hand-coded rules and weights that are learned based on training data." (Ex. 1007 [*Bateman*] at [0072].)

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183. In sum, *Bateman* discloses that its language processing model (machine-learning model) is trained on training data that includes structured conveyance records (training resource data), provisions of wills (an example of training rule data), and hand-coded rules (another example of training rule data). *Bateman* therefore discloses a machine-learning model trained on training data comprising training resource data and training rule data.

184. Finally, as discussed above in **Section XII.B.1.ii**, persons of ordinary skill in the art would have been motivated to provide *Racanelli*'s computing system with *Bateman*'s machine-learning-with-human-review technique for identifying conveyances of assets and interests in assets in wills and generating structured conveyance records reflecting those conveyances, including the features of *Bateman* I have discussed in **Parts 1-3** for Claim 1[c]. I adopt my analysis in **Section XII.B.1.ii** here as well. *Racanelli* in view of *Bateman* therefore renders obvious generating, by the computing system, based on inputting the one or more responses and rule data comprising one or more rules associated with the resources into the one or more machine-learning models, resource data comprising one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields, wherein the one or more machine-learning models are trained based on training data comprising training resource data and training rule data, and wherein the one or more resource data fields are based on the one or more

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resource document fields, and wherein the one or more resource data field values are based on the one or more responses.

- v. **1[d]: generating, by the computing system, based on the resource data, one or more indications associated with the resource allocation instructions, wherein the one or more indications comprise one or more visualizations of the distribution of the one or more assets to the one or more resource recipients; and**

185. *Racanelli* in view of *Bateman* renders obvious generating, by the computing system, based on the resource data, one or more indications associated with the resource allocation instructions, wherein the one or more indications comprise one or more visualizations of the distribution of the one or more assets to the one or more resource recipients.

186. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses the claimed computing system, and *Racanelli* and *Bateman* each disclose the claimed resource allocation instructions and the claimed distribution of the one or more assets to the one or more resource recipients. I adopt that analysis here as well.

187. As discussed above for Claim 1[c] in **Section XII.B.2.iv**, *Racanelli* in view of *Bateman* renders obvious the claimed resource data: structured conveyance records generated using *Bateman*'s machine-learning-with-human-review technique, the structured conveyance records reflecting which recipients will receive which assets under a will. I adopt that analysis here as well.

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188. *Racanelli* teaches generating, based on estate document inputs that reflect who will receive which assets from whom under a will, flowcharts that visualize distributions of assets according to a will's instructions for allocating assets to recipients (one or more indications associated with the resource allocation instructions, wherein the one or more indications comprise one or more visualizations of the distribution of the one or more assets to the one or more resource recipients). In particular, *Racanelli* discloses generating, based on estate document inputs, estate disposition flowcharts that depict distributions of an estate's assets to recipients according to a will's instructions for allocating assets to recipients:

“Generally, various disclosed embodiments receive balance sheet 103 and estate document inputs 105 corresponding to an estate planning client, apply conveyance 109, taxation 111 and other 107 logic to the client's inputs to generate one or more customizable disposition flowcharts 121 visually depicting the flow of estate components to beneficiaries and/or an estimate of the estate's future liquidity status 123.”

(Ex. 1005 [*Racanelli*] at [0029].)

* * *

“Figure 2 illustrates a flowchart representing an exemplary method for modeling estate disposition. In one embodiment, balance sheet inputs are received S201. Estate document inputs are also received S203. The conveyance logic contained within the estate documents is

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applied to the balance sheet and estate document inputs S205. Application of the conveyance logic ascertains which assets, or portions thereof, from the client's balance sheet are conveyed to a particular spouse, child or other beneficiary. Additionally, tax logic, such as applicable federal and state income, death, estate, state specific inheritance taxes, and gift taxes, are applied S207. Application of the tax logic ascertains how much of the gross estate is actually conveyed to the intended beneficiaries. Upon applying this logic, a disposition flowchart representing the flow of assets among parties or financial entities is generated S211."

(Ex. 1005 [*Racanelli*] at [0033].)

* * *

"Various disclosed embodiments advantageously allow for a user, such as a wealth advisor or estate planner, to efficiently and easily customize visual representations of the disposition of a client's estate based on various customizable circumstances. Further, disclosed embodiments allow the client to view the allocation or distribution of their assets and liabilities in their estate plan at a given time and under a variety of simulated circumstances."

(Ex. 1005 [*Racanelli*] at [0084].)

* * *

"Various embodiments also provide estate planners, wealth advisors and clients with customizable and

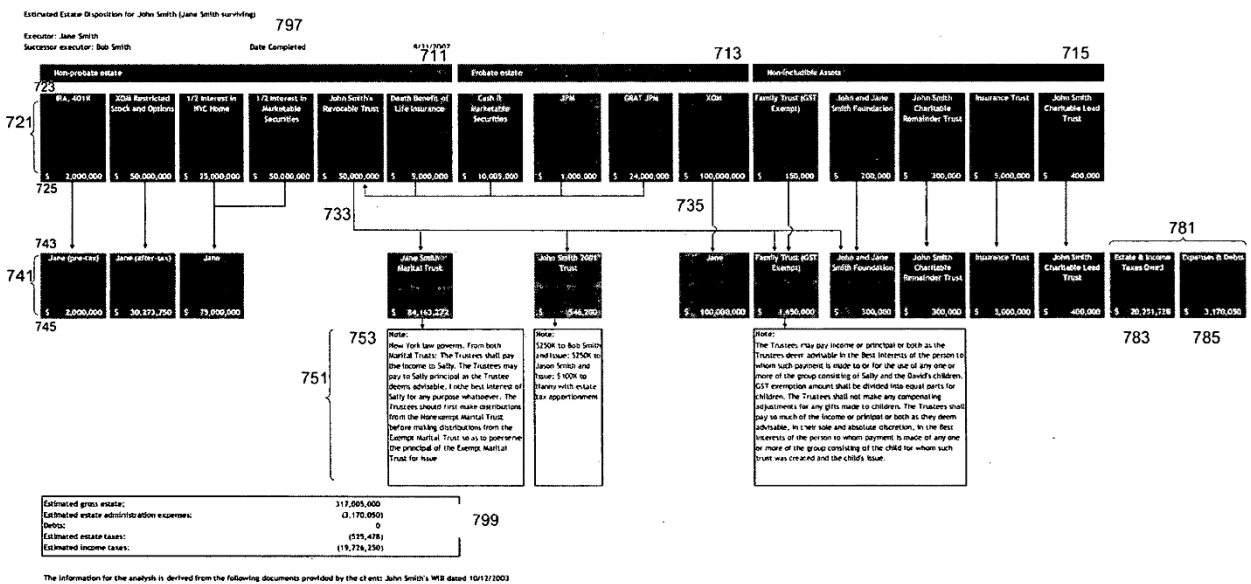
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annotatable flowcharts illustrating future dispositions of the estate that adjust automatically to changes in a client’s balance sheet and estate plan.”

(Ex. 1005 [Racanelli] at [0085].)

189. An example of a flowchart generated based on the estate document inputs appears in Figure 7, which “illustrates a customized first-event disposition flowchart according to a disclosed embodiment.” (Ex. 1005 [Racanelli] at [0055].) The flowchart in Figure 7 can be “generated automatically in accordance with the previously received conveyance logic from the estate documents. For example, the connecting arrows denoting conveyances of assets or liabilities are generated automatically.” (Ex. 1005 [Racanelli] at [0055].) Figure 7 is reproduced below:

Figure 7



(Ex. 1005 [Racanelli] at Fig. 7.)

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190. Figure 7 states, at bottom left, “**The information for the analysis is derived from the following documents provided by the client: John Smith’s Will dated 10/12/2003.**” (Ex. 1005 [*Racanelli*] at Fig. 7.) A detail of Figure 7 with that text enlarged in a callout appears below:

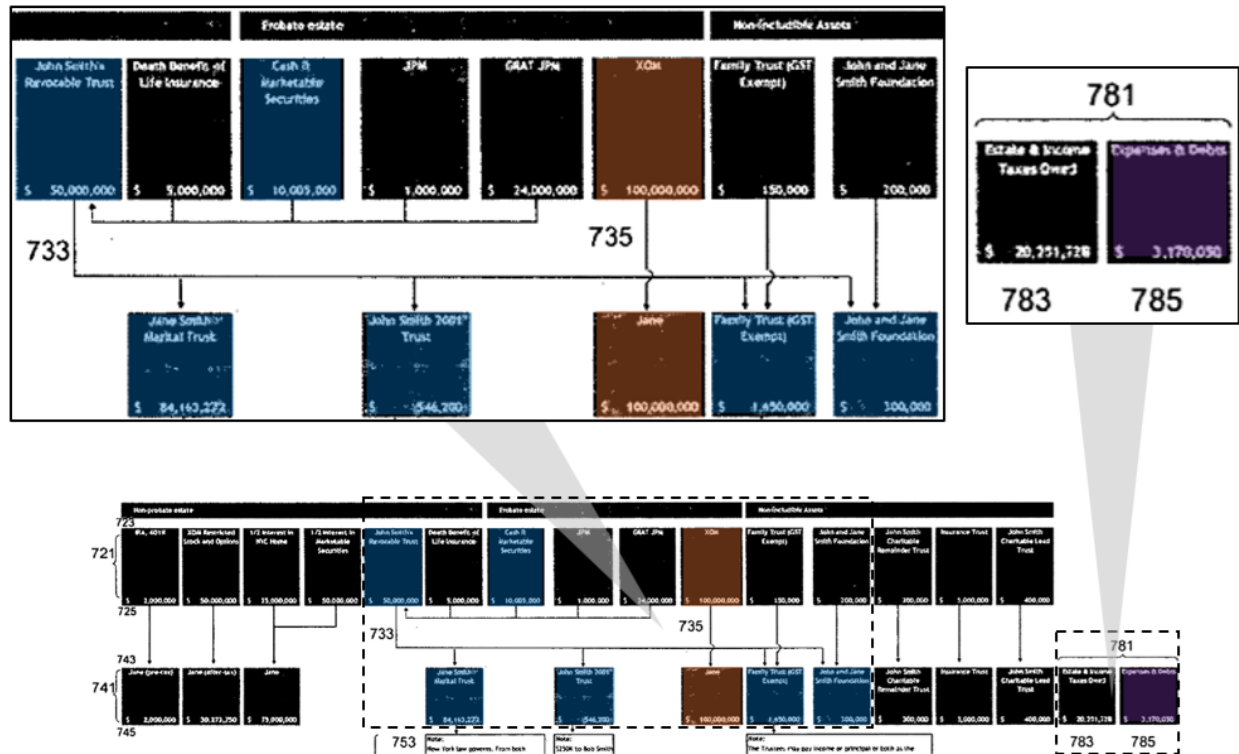


(Ex. 1005 [*Racanelli*] at Fig. 7 (detail; annotations and callout added).)

191. Figure 7 further depicts the distribution of assets to recipients according to John Smith’s will, such as **the distribution of John Smith’s Cash and Marketable Securities to John Smith’s revocable trust, then to the Jane Smith Marital Trust, John Smith 2001 Trust, Family Trust (GST Exempt), and John and Jane Smith Foundation**; and **the distribution of John Smith’s XOM² to Jane Smith**. (Ex. 1005 [*Racanelli*] at Fig. 7.) Figure 7 also depicts “**expenses and debts 785 to be paid out of the estate.**” (Ex. 1005 [*Racanelli*] at [0056].) Those distributions of assets to recipients are shown below:

² “XOM” is the stock ticker symbol for Exxon Mobil.

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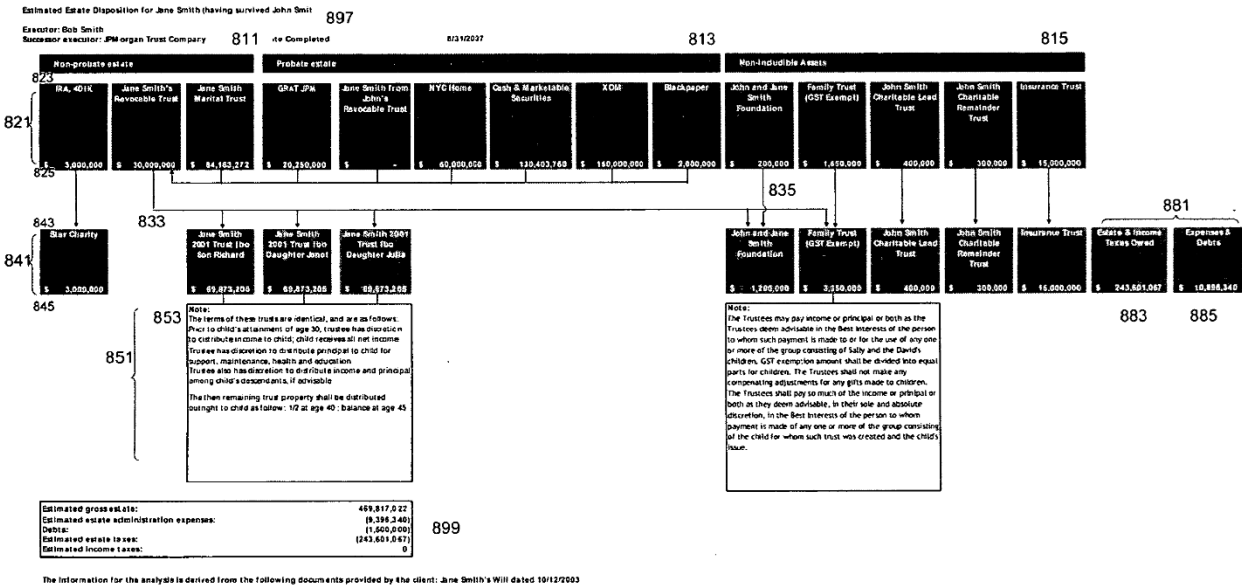


(Ex. 1005 [*Racanelli*] at Fig. 7 (detail; annotations and callouts added).)

192. Another example of a flowchart generated based on the estate document inputs appears in Figure 8, which “illustrates a customized second-event disposition flowchart according [to] a disclosed embodiment.” (Ex. 1005 [*Racanelli*] at [0057].) “In the illustrated example, the second event corresponds to a time when a surviving spouse dies.” (Ex. 1005 [*Racanelli*] at [0057].) Like the flowchart in Figure 7, the flowchart in Figure 8 can be generated automatically. (Ex. 1005 [*Racanelli*] at [0057].) Figure 8 is reproduced below:

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Figure 8



(Ex. 1005 [Racanelli] at Fig. 8.)

193. At bottom left, Figure 8 states, “**The information for the analysis is derived from the following documents provided by the client: Jane Smith’s Will dated 10/12/2003.**” (Ex. 1005 [Racanelli] at Fig. 8.) A detail of Figure 8 with that text enlarged in a callout appears below:



(Ex. 1005 [Racanelli] at Fig. 8 (detail; annotations and callout added).)

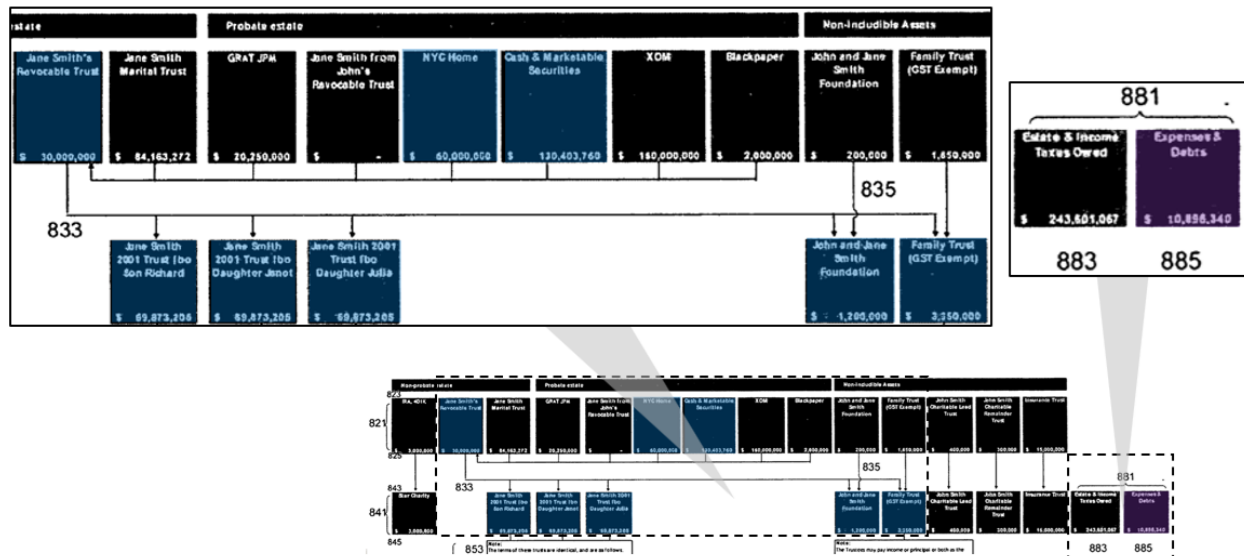
194. Figure 8 further depicts the distribution of assets to recipients according to Jane Smith’s will, such as **the distribution of NYC Home and Cash & Marketable Securities into Jane Smith’s Revocable Trust, then into (1) the Jane Smith 2001 Trusts for son Richard, daughter Janet, and daughter Julia; (2) the**

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John and Jane Smith Foundation; and (3) a family trust. (Ex. 1005 [*Racanelli*]

at Fig. 8.) Figure 8 also depicts “**expenses and debts 885 to be paid out of the estate.**” (Ex. 1005 [*Racanelli*] at [0058].) Those distributions of assets to recipients are shown below:



(Ex. 1005 [*Racanelli*] at Fig. 8 (detail; annotations and callouts added).)

195. As can be seen, the flowcharts in Figure 7 and Figure 8 visualize which recipients receive which assets according to a will's instructions to allocate assets.

196. *Racanelli* describes using its computing system to implement the various functions that *Racanelli* describes, including generating *Racanelli*'s various flowcharts. “Figure 15 is a schematic diagram of an exemplary computing system environment 1500 for use in implementing one or more of the disclosed embodiments. As understood by those of ordinary skill in the art, the various

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embodiments disclosed herein may be implemented by or include a computer or computers.” (Ex. 1005 [*Racanelli*] at [0070].)

197. Finally, as discussed above in **Section XII.B.1.ii**, persons of ordinary skill in the art would have been motivated to *Bateman*’s machine-learning-with-human-review technique to generate structured conveyance records (resource data) for use as the estate document inputs on which *Racanelli*’s flowcharts are based. I adopt that analysis here as well. Thus, *Racanelli* in view of *Bateman* renders obvious *Racanelli*’s computing system generating *Racanelli*’s flowcharts based on resource data: *Bateman*’s structured conveyance records.

198. *Racanelli* in view of *Bateman* therefore renders obvious generating, by the computing system, based on the resource data, one or more indications associated with the resource allocation instructions, wherein the one or more indications comprise one or more visualizations of the distribution of the one or more assets to the one or more resource recipients.

- vi. **1[e]: updating, by the computing system, the one or more visualizations in real-time based on changes in one or more values of the one or more assets.**

199. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious updating, by the computing system, the one or more visualizations in real-time based on changes in one or more values of the one or more assets.

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200. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses the claimed computing system, and *Racanelli* and *Bateman* each disclose the claimed one or more assets. I adopt that analysis here as well.

201. As discussed above for Claim 1[d] in **Section XII.B.2.v**, *Racanelli* in view of *Bateman* renders obvious the claimed one or more visualizations. I adopt that analysis here as well.

202. *Racanelli* discloses automatically updating its flowcharts (one or more visualizations) based on changes in a client's balance sheet, *i.e.*, changes in the values of the client's assets. "Various embodiments also provide estate planners, wealth advisors and clients with customizable and annotatable flowcharts illustrating future dispositions of the estate that adjust automatically to changes in a client's balance sheet and estate plan." (Ex. 1005 [*Racanelli*] at [0085].)

203. *Dintenfass* discloses updating an estate planning visualization in real-time based on changes in one or more values of one or more assets held by the user. (Ex. 1009 [*Dintenfass*] at [0003], [0006], [0023], [0046], [0049], [0062].) *Dintenfass* describes continuously monitoring real-time data feeds associated with sources of user assets, such as a user's account with a financial institution or a user's property. (Ex. 1009 [*Dintenfass*] at [0006], [0023], [0046], [0049].) In particular, *Dintenfass* discloses a software module "configured to continuously monitor the one or more sources of user assets; and update the asset value of the user assets associated

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with the one or more sources of user assets in real-time for display on the estate portal application.” (Ex. 1009 [*Dintenfass*] at [0006].) *Dintenfass* continues, “In response to continuously monitoring the real-time data feeds, the system may be configured to update the asset value associated with the one or more sources of user assets and/or financial status of the beneficiaries in real-time for display on the estate portal application.” (Ex. 1009 [*Dintenfass*] at [0049]. The display that *Dintenfass* describes updating is an “interface” that “may illustrate information associated with the user assets (e.g., amount asset value, type of account, or the like) and/or the financial status of the beneficiaries.” (Ex. 1009 [*Dintenfass*] at [0062].)

204. Finally, as discussed above in **Section XII.B.1.ii**, persons of ordinary skill in the art would have been motivated to combine *Racanelli* and *Dintenfass* to provide *Racanelli*’s computing system with *Dintenfass*’s techniques for monitoring asset values in real-time and updating an estate planning visualization in real-time as asset values change, thereby updating *Racanelli*’s flowcharts in real-time based on changes in asset values. I adopt that analysis here as well. *Racanelli* in view of *Bateman* and *Dintenfass* therefore renders obvious updating, by the computing system, the one or more visualizations in real-time based on changes in one or more values of the one or more assets.

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3. Claim 2

i. 2[p]: The computer-implemented method of claim 1, further comprising:

205. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the computer-implemented method of Claim 1, as discussed above in **Section XII.B.2.**

I adopt that analysis here as well.

ii. 2[a]: receiving, by the computing system, an asset valuation request associated with a projected asset valuation of the one or more assets; and

206. *Racanelli* renders obvious receiving, by the computing system, an asset valuation request associated with a projected asset valuation of the one or more assets.

207. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

208. *Racanelli* discloses that its computing system implements the various techniques disclosed in *Racanelli*: “Figure 15 is a schematic diagram of an exemplary computing system environment 1500 for use in implementing one or more of the disclosed embodiments. As understood by those of ordinary skill in the art, the various embodiments disclosed herein may be implemented by or include a computer or computers.” (Ex. 1005 [*Racanelli*] at [0070].) *Racanelli* further discloses that the computing system receives commands from a user: “A user may enter commands and information into the computer through a user interface that

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includes input devices 1553 such as a keyboard and pointing device, commonly referred to as a mouse, trackball or touch pad.” (Ex. 1005 [*Racanelli*] at [0080].)

Racanelli further discloses that its computing system includes a processing unit that executes commands to implement the techniques disclosed in *Racanelli*. (Ex. 1005 [*Racanelli*] at [0078].) Thus, *Racanelli* discloses a computing system that receives a command to perform the techniques disclosed in *Racanelli*.

209. One technique that *Racanelli* describes its computing system performing is projecting the value of one or more assets associated with an estate. (Ex. 1005 [*Racanelli*] at [0032], [0051], [0067].) For example, *Racanelli* describes projecting the estimated growth or contraction of an estate’s assets based on input from an estate planner:

“The estimated growth or contraction of assets and liabilities between the death of the first and second spouses (or other events) may be accomplished using one or more of a variety of known methods, including probabilistic modeling techniques disclosed in U.S. Patent No. 7,031,935 to Chhabra et al., the entirety of which is incorporated by reference herewith. The number of years between significant events or estimated scenarios may be input by the estate planner or estimated based, for example, on the statistical life expectancies of the client and/ or spouse.”

(Ex. 1005 [*Racanelli*] at [0051].)

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210. *Racanelli* also describes estimating the growth of the assets of an estate using an asset-based rate and timing or event inputs:

“In the illustrated embodiment, the model generates a base case for the estate disposition tax and liquidity estimates based on a first set of timing or event inputs S1401. For example, the base case may run the model as if the client dies that day or in the current year. Other inputs may be the delayed death of the client and/or spouse, as well as the relative time between these deaths. Then, by varying one or more timing or event inputs (for example, illustrated schematically at 151 of Fig. 1), alternative estate disposition and liquidity estimates are generated S1403. For example, a second iteration may run the model as if the client dies in 10 years and account for the potential growth in the estate before the client’s death. This estimated growth may be estimated in a variety of methods, including but not limited to, a fixed rate of growth, an asset based rate, an actual rate, the method described in U.S. Patent No. 7,031,935 to Chhabra et al. described above, or another suitable method.”

(Ex. 1005 [*Racanelli*] at [0067].)

211. Between *Racanelli*’s disclosure of its computing system performing commands input by a user and generating an asset projection valuation based on input from an estate planner, persons of ordinary skill in the art would have

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understood that *Racanelli*'s computing system receives an asset valuation request associated with a projected asset valuation of the one or more assets.

iii. 2[b]: determining, by the computing system, based on the resource data, the projected asset valuation of the one or more assets,

212. *Racanelli* in view of *Bateman* renders obvious determining, by the computing system, based on the resource data, the projected asset valuation of the one or more assets.

213. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

214. As discussed above for Claim 1[c] in **Section XII.B.2.iv**, *Racanelli* in view of *Bateman* renders obvious the claimed resource data: data that indicates which recipients will receive which assets according to a will or other document. I adopt that analysis here as well.

215. *Racanelli* discloses that its computing system implements the various techniques disclosed in *Racanelli*: "Figure 15 is a schematic diagram of an exemplary computing system environment 1500 for use in implementing one or more of the disclosed embodiments. As understood by those of ordinary skill in the art, the various embodiments disclosed herein may be implemented by or include a computer or computers." (Ex. 1005 [*Racanelli*] at [0070].)

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216. One technique that *Racanelli* discloses projecting an asset valuation based on data that indicates which recipients will receive which assets: namely, it discloses projecting the values of an estate's assets to be disposed of according to a will or other document. Broadly, *Racanelli* describes "projecting the value of the estate at a future time to show the impact of various longer term strategies." (Ex. 1005 [*Racanelli*] at [0032].) Likewise, *Racanelli* describes projecting the value of the estate's assets according to inputs from an estate planner:

"The estimated growth or contraction of assets and liabilities between the death of the first and second spouses (or other events) may be accomplished using one or more of a variety of known methods, including probabilistic modeling techniques disclosed in U.S. Patent No. 7,031,935 to Chhabra et al., the entirety of which is incorporated by reference herewith. The number of years between significant events or estimated scenarios may be input by the estate planner or estimated based, for example, on the statistical life expectancies of the client and/ or spouse."

(Ex. 1005 [*Racanelli*] at [0051].)

217. *Racanelli* also describes estimating the growth of the assets of an estate using an asset-based rate and timing or event inputs:

"Figure 14 illustrates an exemplary output feature of the disclosed model related to simulating alternative events or

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circumstances. . . . In one embodiment, the model generates a base case for the estate disposition tax and liquidity estimates based on a first set of timing or event inputs S1401. For example, the base case may run the model as if the client dies that day or in the current year. Other inputs may be the delayed death of the client and/or spouse, as well as the relative time between these deaths. Then, by varying one or more timing or event inputs (for example, illustrated schematically at 151 of Fig. 1), alternative estate disposition and liquidity estimates are generated S1403. For example, a second iteration may run the model as if the client dies in 10 years and account for the potential growth in the estate before the client's death. This estimated growth may be estimated in a variety of methods, including but not limited to, a fixed rate of growth, an asset based rate, an actual rate, the method described in U.S. Patent No. 7,031,935 to Chhabra et al. described above, or another suitable method.”

(Ex. 1005 [*Racanelli*] at [0067].)

218. Further, *Racanelli* discloses generating an “estate plan estimate” based on conveyance instructions that reflect which recipients receive which assets, which instructions are reflected in the resource data as previously discussed. *Racanelli* describes “estate plan estimates” as follows:

“Additional embodiments may also implement a portion or combination of the various analyses and simulations

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described in Figs. 12-14 to advantageously provide a wide spectrum of estate plan estimates under a variety of different circumstances involving a confluence of factors such as event timing, asset and liability allocation, and conveyance instructions.”

(Ex. 1005 [*Racanelli*] at [0069].)

219. The “analyses and simulations described in Figs. 12-14” include, as described for Figure 14, projecting the estimated growth of an estate via “a variety of methods, including but not limited to, a fixed rate of growth, an asset based rate, an actual rate, the method described in U.S. Patent No. 7,031,935 to Chhabra et al. described above, or another suitable method.” (Ex. 1005 [*Racanelli*] at [0067].)

220. In sum, *Racanelli* in view of *Bateman* renders obvious “resource data” that reflects the assets in an estate and the recipients of those assets, and *Racanelli* discloses a computing system projecting the value of the assets of the estate based on data reflecting which recipients will receive which assets—*i.e.*, resource data. *Racanelli* in view of *Bateman* therefore renders obvious determining, by the computing system, based on the resource data, the projected asset valuation of the one or more assets.

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- iv. **2[c]: wherein the one or more indications associated with the resource allocation instructions comprise the projected asset valuation of the one or more assets.**

221. *Racanelli* in view of *Bateman* renders obvious wherein the one or more indications associated with the resource allocation instructions comprise the projected asset valuation of the one or more assets.

222. As discussed above for Claim 1[d] in **Section XII.B.2.v**, *Racanelli* in view of *Bateman* renders obvious the claimed one or more indications associated with the resource allocation instructions. I adopt that analysis here as well.

223. As discussed above for Claim 2[b] in **Section XII.B.3.iii**, *Racanelli* in view of *Bateman* renders obvious the projected asset valuation of the one or more assets. I adopt that analysis here as well.

224. As discussed, *Racanelli* describes estimating the growth of the assets of an estate using an asset-based rate and timing or event inputs. (Ex. 1005 [*Racanelli*] at [0032], [0051], [0067].) *Racanelli* further describes that “[t]hese alternative timing or event input scenarios may optionally be further depicted in corresponding flow charts and liquidity analysis outputs as described elsewhere.” (Ex. 1005 [*Racanelli*] at [0069].) As those “alternative timing or event input scenarios” include an asset value projection, *Racanelli* discloses that its projected asset valuation can be depicted in a corresponding flowchart. *Racanelli* therefore

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discloses wherein the one or more indications associated with the resource allocation instructions comprise the projected asset valuation of the one or more assets.

4. Claim 4

i. 4[p]: The computer-implemented method of claim 1, further comprising:

225. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the computer-implemented method of Claim 1, as discussed above in **Section XII.B.2.**

I adopt that analysis here as well.

ii. 4[a]: receiving, by the computing system, an asset distribution request associated with a projected asset distribution of the one or more assets to the one or more entities;

226. *Racanelli* renders obvious receiving, by the computing system, an asset distribution request associated with a projected asset distribution of the one or more assets to the one or more entities.

227. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

228. *Racanelli* discloses that its computing system implements the various techniques disclosed in *Racanelli*: “Figure 15 is a schematic diagram of an exemplary computing system environment 1500 for use in implementing one or more of the disclosed embodiments. As understood by those of ordinary skill in the art, the various embodiments disclosed herein may be implemented by or include a

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computer or computers.” (Ex. 1005 [*Racanelli*] at [0070].) *Racanelli* further discloses that the computing system receives commands from a user: “A user may enter commands and information into the computer through a user interface that includes input devices 1553 such as a keyboard and pointing device, commonly referred to as a mouse, trackball or touch pad.” (Ex. 1005 [*Racanelli*] at [0080].) *Racanelli* further discloses that its computing system includes a processing unit that executes commands to implement the techniques disclosed in *Racanelli*. (Ex. 1005 [*Racanelli*] at [0078].) Thus, *Racanelli* discloses a computing system that receives a command (request) to perform the techniques disclosed in *Racanelli*.

229. One technique that *Racanelli* describes performing is projecting how the assets of an estate will be distributed to the recipients of the estate based on input from an estate planner. Those recipients are “one or more entities,” as Claim 1 explains that the “one or more entities” comprise “one or more resource recipients.”

230. *Racanelli* describes projecting estate dispositions (asset distributions) across various alternatives and scenarios, such as the timing of the deaths of the testator and the testator’s spouse. (Ex. 1005 [*Racanelli*] at [0029], [0084].) For example, *Racanelli* describes that “disclosed embodiments allow the client to view the allocation or distribution of their assets and liabilities in their estate plan at a given time and under a variety of simulated circumstances.” (Ex. 1005 [*Racanelli*]

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at [0084].) The simulated circumstances used to project those estate dispositions can include timing or event inputs provided or designated by an estate planner:

“In one embodiment, timing or event inputs 151 allow for the projection of estate disposition and tax events for a wide range of circumstances, including, but not limited to, the absolute and relative timing of the deaths of the client and/or spouse. For example, the death of the client might occur in 10 years, and the death of the surviving spouse 15 years beyond then. Alternatively, the client’s spouse might die before the client.”

(Ex. 1005 [*Racanelli*] at [0029].)

* * *

“Additional iterations of the disposition flowcharts, tax estimates and liquidity analysis may optionally be performed based upon subsequent events or changes in circumstances (for example, the death of a spouse or other beneficiary) or for multiple generations of conveyances (for example, to model the estate disposition after the death of children and grand-children).”

(Ex. 1005 [*Racanelli*] at [0033].)

* * *

“The number of years between significant events or estimated scenarios may be input by the estate planner or estimated based, for example, on the statistical life expectancies of the client and/ or spouse.”

(Ex. 1005 [*Racanelli*] at [0051].)

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* * *

“The second event may be designated by the estate planner to be coincident with or after the first event. In the illustrated example, the second event corresponds to a time when a surviving spouse dies. In other embodiments, additional events (for instance, a third event corresponding to the death of a child beneficiary of the original estate client) may optionally be modeled to provide a multi-generational view of the estate plan.”

(Ex. 1005 [*Racanelli*] at [0057].)

231. Between *Racanelli*’s disclosure of its computing system performing commands input by a user and generating predicted asset distributions based on timing or event inputs provided or designated by an estate planner, persons of ordinary skill in the art would have understood that *Racanelli*’s computing system receives an asset distribution request associated with a projected asset distribution of the one or more assets to the one or more entities.

iii. 4[b]: determining, by the computing system, based on the resource data, one or more relationships between the one or more entities; and

232. *Racanelli* in view of *Bateman* renders obvious determining, by the computing system, based on the resource data, one or more relationships between the one or more entities.

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233. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

234. As discussed above for Claim 1[c] in **Section XII.B.2.iv**, *Racanelli* in view of *Bateman* renders obvious the claimed resource data, which reflects assets and their associated recipients (entities) extracted from a will. I adopt that analysis here as well.

235. That resource data includes the names of asset recipients (entities) extracted from a will or other document. (Ex. 1007 [*Bateman*] at [0067], [0071], [0074], [0108].) *Bateman* further discloses that its language processing model can determine the relationships of named entities identified in data extracted from a will:

“In some embodiments, language processing models may include natural language processing models configured to extract structured information from human or natural language contained in the one or more sets of data. Natural language processing (NLP) models may be configured for named entity recognition. In some embodiments, an NLP model may be configured to extract proper names from the unstructured sets of data and the type of the extracted names (e.g., person, location, and/or organization). In some embodiments, an NLP model may be configured to identify the relationships among named entities (e.g., who is the wife of whom).”

(Ex. 1007 [*Bateman*] at [0066].)

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236. That *Bateman* describes identifying relationships among extracted named entities shows that *Bateman*'s language processing model determines relationships based on information that has been extracted, *i.e.*, the resource data that reflects which recipients (entities) will receive which assets.

237. Finally, as discussed above in **Section XII.B.1.ii**, persons of ordinary skill in the art would have been motivated to add *Bateman*'s functionality to *Racanelli*'s computing system. I adopt that analysis here as well. *Racanelli* in view of *Bateman* therefore renders obvious determining, by the computing system, based on the resource data, one or more relationships between the one or more entities.

iv. **4[c]: determining, by the computing system, based on the resource data and the one or more relationships between the one or more entities, a plurality of projected asset distributions of the one or more assets to the one or more entities,**

238. *Racanelli* in view of *Bateman* renders obvious determining, by the computing system, based on the resource data and the one or more relationships between the one or more entities, a plurality of projected asset distributions of the one or more assets to the one or more entities.

239. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

240. As discussed above for Claim 1[c] in **Section XII.B.2.iv**, *Racanelli* in view of *Bateman* renders obvious the claimed resource data, which reflects assets

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and their associated recipients (entities) extracted from a will. I adopt that analysis here as well.

241. As discussed above for Claim 4[b] in **Section XII.B.4.iii**, *Racanelli* in view of *Bateman* renders obvious the claimed one or more relationships between the one or more entities. I adopt that analysis here as well.

242. *Racanelli* in view of *Bateman* renders obvious determining a plurality of projected asset distributions based on the assets listed in the resource data and relationships between the one or more entities. As discussed for Claim 1[d] in **Section XII.B.2.v**, *Racanelli* in view of *Bateman* renders obvious generating a flowchart reflecting projected asset distributions based on assets identified in the resource data. I adopt that analysis here as well. *Racanelli* further teaches using relationships between recipients to project distributions of those assets to asset recipients. *Racanelli* teaches that feature in two ways.

243. *First*, *Racanelli* teaches determining a plurality of projected asset distributions based on the identified assets and a relationship between a first spouse and a second spouse, each of whom are recipients under each other's wills (Ex. 1005 [*Racanelli*] at [0045]), based on the relative timing of the first spouse's death and the second spouse's death. As an example, *Racanelli* describes generating visualizations that project estate dispositions (asset distributions) based on a "wide range of circumstances" such as the timing of the spouses' respective deaths:

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“In one embodiment, timing or event inputs 151 allow for the projection of estate disposition and tax events for a wide range of circumstances, including, but not limited to, the absolute and relative timing of the deaths of the client and/or spouse. For example, the death of the client might occur in 10 years, and the death of the surviving spouse 15 years beyond then. Alternatively, the client’s spouse might die before the client.”

(Ex. 1005 [*Racanelli*] at [0029].)

* * *

“In an additional embodiment, the model provides simulations 135 of alternative events, event timing and other changes in circumstances impacting the estate. For example, this embodiment allows for comparison of the estate disposition analysis based upon different absolute or relative timing in the deaths of the client and spouse.”

(Ex. 1005 [*Racanelli*] at [0032].)

* * *

“Additional iterations of the disposition flowcharts, tax estimates and liquidity analysis may optionally be performed based upon subsequent events or changes in circumstances (for example, the death of a spouse or other beneficiary) or for multiple generations of conveyances (for example, to model the estate disposition after the death of children and grand-children).”

(Ex. 1005 [*Racanelli*] at [0033].)

* * *

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“Further, disclosed embodiments allow the client to view the allocation or distribution of their assets and liabilities in their estate plan at a given time and under a variety of simulated circumstances.”

(Ex. 1005 [*Racanelli*] at [0084].)

244. *Second*, *Racanelli* teaches determining a plurality of projected asset distributions based on the identified assets and relationships between children and grandchildren of a testator to model asset distributions across multiple generations. As an example, *Racanelli* describes generating visualizations that project estate dispositions (asset distributions) across multiple generations:

“Additional iterations of the disposition flowcharts, tax estimates and liquidity analysis may optionally be performed based upon subsequent events or changes in circumstances (for example, the death of a spouse or other beneficiary) or for multiple generations of conveyances (for example, to model the estate disposition after the death of children and grand-children).”

(Ex. 1005 [*Racanelli*] at [0033].)

* * *

“In other embodiments, additional events (for instance, a third event corresponding to the death of a child beneficiary of the original estate client) may optionally be modeled to provide a multi-generational view of the estate plan. In one embodiment, third and subsequent event

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models account for generation skipping tax (GST) implications.”

(Ex. 1005 [*Racanelli*] at [0057].)

* * *

“Further, disclosed embodiments allow the client to view the allocation or distribution of their assets and liabilities in their estate plan at a given time and under a variety of simulated circumstances.”

(Ex. 1005 [*Racanelli*] at [0084].)

- v. **4[d]: wherein the one or more indications associated with the resource allocation instructions comprise the plurality of projected asset distributions of the one or more assets to the one or more entities.**

245. *Racanelli* in view of *Bateman* renders obvious wherein the one or more indications associated with the resource allocation instructions comprise the plurality of projected asset distributions of the one or more assets to the one or more entities.

246. As discussed above for Claim 1[d] in **Section XII.B.2.v**, *Racanelli* in view of *Bateman* renders obvious the claimed one or more indications associated with the resource allocation instructions. I adopt that analysis here as well.

247. As discussed above for Claim 4[c] in **Section XII.B.4.iv**, *Racanelli* in view of *Bateman* renders obvious the plurality of projected asset distributions of the one or more assets to the one or more entities. I adopt that analysis here as well.

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248. *Racanelli* describes visualizing projected asset distributions: “disclosed embodiments allow the client to view the allocation or distribution of their assets and liabilities in their estate plan at a given time and under a variety of simulated circumstances.” (Ex. 1005 [*Racanelli*] at [0084].) *Racanelli* further discloses generating additional iterations of its flowcharts that reflect projected asset distributions of the one or more assets to the one or more entities, including both sets of projected asset distributions I described for Claim 4[c] in in **Section XII.B.4.iv**: (1) projected distributions for spouses who are recipients under each other’s wills; and (2) projected multi-generational distributions with child and grandchild recipients. As *Racanelli* explains:

“Additional iterations of the disposition flowcharts, tax estimates and liquidity analysis may optionally be performed based upon subsequent events or changes in circumstances (for example, the death of a spouse or other beneficiary) or for multiple generations of conveyances (for example, to model the estate disposition after the death of children and grand-children).”

(Ex. 1005 [*Racanelli*] at [0033].)

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5. Claim 5

i. 5[p]: The computer-implemented method of claim 4,

249. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the computer-implemented method of Claim 4, as discussed above in **Section XII.B.4.**

I adopt that analysis here as well.

ii. 5[a]: wherein the one or more machine-learning models comprise one or more machine-learning distribution projection models, and

250. *Racanelli* in view of *Bateman* renders obvious wherein the one or more machine-learning models comprise one or more machine-learning distribution projection models.

251. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Bateman* discloses one or more machine-learning models. I adopt that analysis here as well.

252. As discussed above for Claim 1[c] in **Section XII.B.2.iv**, *Racanelli* in view of *Bateman* renders obvious using *Bateman*'s machine-learning model to generate resource data reflecting which recipients will receive which assets under a will. I adopt that analysis here as well. Because the resource data reflects a plurality of projected asset distributions under the will, using *Bateman*'s machine-learning model to generate that resource data makes *Bateman*'s machine-learning model a distribution projection model. For that reason alone, *Racanelli* in view of *Bateman*

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renders obvious wherein the one or more machine-learning models comprise one or more machine-learning distribution projection models.

253. To the extent more is required, as discussed above for Claim 4[b] in **Section XII.B.4.iii**, *Racanelli* in view of *Bateman* renders obvious determining, by the computing system, based on the resource data, one or more relationships between the one or more entities. I adopt that analysis here as well. The same disclosures render obvious relationship data associated with the one or more relationships.

254. As discussed above for Claim 4[c] in **Section XII.B.4.iv**, *Racanelli* in view of *Bateman* renders obvious determining, by the computing system, based on the resource data and the one or more relationships between the one or more entities, a plurality of projected asset distributions of the one or more assets to the one or more entities. I adopt that analysis here as well.

255. Persons of ordinary skill in the art would have recognized that *Bateman*'s machine-learning model would have been well-suited to generate projected asset distributions based on identified relationships between recipients as taught by *Racanelli*—such as asset distributions to spouses who are recipients under each other's wills, or multi-generational asset distributions. (Ex. 1005 [*Racanelli*] at [0029], [0032]-[0033], [0045], [0057], [0084].)

256. At bottom, *Racanelli*'s projected asset distributions are data visualizations that depict who is projected to receive which assets based on estate

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document inputs (here, the resource data) and relationship data (here, the relationships identified by *Bateman*'s machine-learning model). (Ex. 1005 [*Racanelli*] at [0029], [0032]-[0033], [0045], [0057], [0084].) With *Bateman*'s machine-learning model having generated the inputs for those projected asset distributions—resource data identifying assets to be distributed and relationship data used to project distributions of those assets—persons of ordinary skill in the art would have found it logical and obvious to configure *Bateman*'s machine-learning model to implement *Racanelli*'s techniques for generating projected asset distributions based on resource data and relationship data. Using a machine-learning model to generate data visualizations was a known technique that made it easy for users without technical knowledge to generate data visualizations. (Ex. 1012 [*Zhao*] at 82; Ex. 1015 [*Maddigan*] at 1; Ex. 1016 [*Liu*] at 7.)

257. For those reasons as well, *Racanelli* in view of *Bateman* renders obvious wherein the one or more machine-learning models comprise one or more machine-learning distribution projection models.

- iii. **5[b]: wherein the projected asset distribution is based on inputting the resource data and relationship data associated with the one or more relationships into the one or more machine-learning distribution projection models that are configured to generate the projected asset distribution.**

258. *Racanelli* in view of *Bateman* renders obvious wherein the projected asset distribution is based on inputting the resource data and relationship data

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associated with the one or more relationships into the one or more machine-learning distribution projection models that are configured to generate the projected asset distribution.

259. As discussed above for Claim 1[c] in **Section XII.B.2.iv**, *Racanelli* in view of *Bateman* renders obvious the claimed resource data: data that indicates which recipients will receive which assets according to a will or other document. I adopt that analysis here as well.

260. As discussed above for Claim 4[b] in **Section XII.B.4.iii**, *Racanelli* in view of *Bateman* renders obvious determining, by the computing system, based on the resource data, one or more relationships between the one or more entities. I adopt that analysis here as well. The relationships that are determined constitute relationship data associated with the one or more relationships.

261. As discussed above for Claim 4[c] in **Section XII.B.4.iv**, *Racanelli* in view of *Bateman* renders obvious determining, by the computing system, based on the resource data and the one or more relationships between the one or more entities, a plurality of projected asset distributions of the one or more assets to the one or more entities. I adopt that analysis here as well.

262. As discussed above for Claim 5[a] in **Section XII.B.5.ii**, *Racanelli* in view of *Bateman* renders obvious one or more machine-learning distribution projection models. I adopt that analysis here as well. The same disclosures render

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obvious a machine-learning distribution projection model configured to generate the projected asset distribution.

263. *Racanelli* in view of *Bateman* further renders obvious inputting the resource data and relationship data associated with the one or more relationships into the one or more machine-learning distribution projection models to generate the projected asset distribution.

264. Starting with resource data, as discussed above for Claim 4[b] in **Section XII.B.4.iii**, *Racanelli* in view of *Bateman* renders obvious inputting resource data into *Bateman*'s language processing model (machine-learning model) in order to identify relationships between asset recipients in *Bateman*'s structured conveyance records, thereby generating relationship data. (Ex. 1007 [*Bateman*] at [0066].) I adopt that analysis here as well.

265. As for relationship data, persons of ordinary skill in the art would have been motivated to configure *Bateman*'s machine-learning model to implement *Racanelli*'s techniques for projecting asset distributions, as discussed above for Claim 5[a] in **Section XII.B.5.ii**. The *Bateman-Racanelli* machine-learning model, in addition to generating relationship data, uses that relationship data as an input for projecting asset distributions, such as asset distributions to spouses who are recipients under each other's wills, or multi-generational asset distributions. (Ex. 1005 [*Racanelli*] at [0029], [0032]-[0033], [0045], [0057].)

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266. In sum, *Racanelli* in view of *Bateman* renders obvious inputting resource data (to identify relationships between recipients) and relationship data (the identified relationships) into the *Bateman-Racanelli* machine-learning model to generate projected asset distributions. *Racanelli* in view of *Bateman* therefore renders obvious wherein the projected asset distribution is based on inputting the resource data and relationship data associated with the one or more relationships into the one or more machine-learning distribution projection models that are configured to generate the projected asset distribution.

6. Claim 6

i. 6[p]: The computer-implemented method of claim 1, further comprising:

267. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the computer-implemented method of Claim 1, as discussed above in **Section XII.B.2**.

I adopt that analysis here as well.

ii. 6[a]: receiving, by the computing system, one or more conditions associated with the one or more entities or the one or more assets; and

268. *Racanelli* discloses receiving, by the computing system, one or more conditions associated with the one or more entities or the one or more assets.

269. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

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270. *Racanelli* discloses that its computing system implements the various techniques disclosed in *Racanelli*: “Figure 15 is a schematic diagram of an exemplary computing system environment 1500 for use in implementing one or more of the disclosed embodiments. As understood by those of ordinary skill in the art, the various embodiments disclosed herein may be implemented by or include a computer or computers.” (Ex. 1005 [*Racanelli*] at [0070].)

271. One technique that *Racanelli* discloses involves receiving one or more conditions associated with one or more entities or one or more assets.

272. *First*, *Racanelli* discloses receiving one or more conditions associated with one or more entities.

273. The “one or more entities” in Claim 6 refers to “one or more entities comprising one or more resource recipients” in Claim 1. *Racanelli* describes a testator’s spouse as an example of a recipient of assets distributed by a will—*i.e.*, an entity comprising a resource recipient. (Ex. 1005 [*Racanelli*] at [0045]-[0046].) *Racanelli* further discloses receiving an input reflecting the life expectancy of the testator’s spouse. For example, “[t]he number of years between significant events or estimated scenarios may be input by the estate planner or estimated based, for example, on the statistical life expectancies of the client and/ or spouse.” (Ex. 1005 [*Racanelli*] at [0051].) *Racanelli* further describes a model that “receives inputs related to factors affecting the life expectancy of the client and/or spouse (for

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example, health problems, smoking and drinking habits, etc.) to probabilistically estimate, using actuarial or other suitable methods, the likely timing inputs and resultant disposition of the estate given a certain estate plan strategy.” (Ex. 1005 [*Racanelli*] at [0068].)

274. *Second*, *Racanelli* discloses receiving one or more conditions associated with one or more assets of an estate.

275. *Racanelli* discloses receiving three conditions associated with one or more assets of the estate. Those three conditions are (1) a “base case” valuation of the estate’s assets as if the client were to die that day or in the current year; (2) a growth rate of the estate; and (3) timing or event inputs reflecting the amount of time over which the estate is expected to grow:

“For example, the base case may run the model as if the client dies that day or in the current year. Other inputs may be the delayed death of the client and/or spouse, as well as the relative time between these deaths. Then, by varying one or more timing or event inputs (for example, illustrated schematically at 151 of Fig. 1), alternative estate disposition and liquidity estimates are generated S1403. For example, a second iteration may run the model as if the client dies in 10 years and account for the potential growth in the estate before the client’s death. This estimated growth may be estimated in a variety of methods, including but not limited to, a fixed rate of

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growth, an asset based rate, an actual rate, the method described in U.S. Patent No. 7,031,935 to Chhabra et al. described above, or another suitable method.”

(Ex. 1005 [*Racanelli*] at [0067].)

276. *Racanelli* therefore discloses receiving, by the computing system, one or more conditions associated with the one or more entities or the one or more assets.

iii. **6[b]: determining, by the computing system, one or more scenarios associated with the one or more conditions, wherein the one or more scenarios comprise one or more projected valuations of the one or more assets or one or more predicted distributions of the one or more assets to the one or more resource recipients,**

277. *Racanelli* discloses determining, by the computing system, one or more scenarios associated with the one or more conditions, wherein the one or more scenarios comprise one or more projected valuations of the one or more assets or one or more predicted distributions of the one or more assets to the one or more resource recipients.

278. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

279. *Racanelli* discloses that its computing system implements the various techniques disclosed in *Racanelli*: “Figure 15 is a schematic diagram of an exemplary computing system environment 1500 for use in implementing one or more of the disclosed embodiments. As understood by those of ordinary skill in the

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art, the various embodiments disclosed herein may be implemented by or include a computer or computers.” (Ex. 1005 [*Racanelli*] at [0070].)

280. One technique that *Racanelli* discloses is determining one or more scenarios associated with one or more conditions. As discussed above for Claim 6[a] in **Section XII.B.6.ii**, *Racanelli* discloses one or more conditions, including a life expectancy of the testator’s spouse; a “base case” valuation of the estate’s assets; a growth rate; and an input amount of time over which an estate is expected to grow. I adopt that analysis here as well. *Racanelli* further discloses determining, based on those conditions, both a projected asset valuation and a predicted distribution of assets to one or more recipients.

281. *First*, *Racanelli* discloses determining a projected asset valuation scenario associated with one or more conditions. For example, *Racanelli* discloses projecting a future valuation of the estate’s assets based on conditions that include a “base case” valuation of the estate’s assets; a growth rate; and an input amount of time over which the estate is expected to grow, such as the time before a spouse dies:

“The second estate document input interface further provides a view of the total assets at the time of the second event (death) 515. The estimated growth or contraction of assets and liabilities between the death of the first and second spouses (or other events) may be accomplished using one or more of a variety of known methods, including probabilistic modeling techniques disclosed in

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U.S. Patent No. 7,031,935 to Chhabra et al., the entirety of which is incorporated by reference herewith. The number of years between significant events or estimated scenarios may be input by the estate planner or estimated based, for example, on the statistical life expectancies of the client and/ or spouse.”

(Ex. 1005 [*Racanelli*] at [0051].)

* * *

“For example, the base case may run the model as if the client dies that day or in the current year. Other inputs may be the delayed death of the client and/or spouse, as well as the relative time between these deaths. Then, by varying one or more timing or event inputs (for example, illustrated schematically at 151 of Fig. 1), alternative estate disposition and liquidity estimates are generated S1403. For example, a second iteration may run the model as if the client dies in 10 years and account for the potential growth in the estate before the client’s death. This estimated growth may be estimated in a variety of methods, including but not limited to, a fixed rate of growth, an asset based rate, an actual rate, the method described in U.S. Patent No. 7,031,935 to Chhabra et al. described above, or another suitable method.”

(Ex. 1005 [*Racanelli*] at [0067].)

282. *Second*, *Racanelli* discloses determining a scenario comprising a predicted asset distribution to one or more recipients, which predicted asset

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distribution is associated with one or more conditions. *Racanelli* generally describes that “disclosed embodiments allow the client to view the allocation or distribution of their assets and liabilities in their estate plan at a given time and under a variety of simulated circumstances.” (Ex. 1005 [*Racanelli*] at [0084].) *Racanelli* particularly describes determining a predicted estate disposition (asset distribution) scenarios associated with a life expectancy of the testator’s spouse:

“For example, the timing of the death of the client may vary and directly impact the projected estate disposition analysis. Additionally, the timing of the death of the client’s spouse, or the relative time between the spouses’ deaths also may impact the analysis. In the illustrated embodiment, the model generates a base case for the estate disposition tax and liquidity estimates based on a first set of timing or event inputs S1401. For example, the base case may run the model as if the client dies that day or in the current year. Other inputs may be the delayed death of the client and/or spouse, as well as the relative time between these deaths. Then, by varying one or more timing or event inputs (for example, illustrated schematically at 151 of Fig. 1), alternative estate disposition and liquidity estimates are generated S1403.”

(Ex. 1005 [*Racanelli*] at [0067] (underlining added).)

* * *

“In another embodiment, the model receives inputs related to factors affecting the life expectancy of the client and/or

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spouse (for example, health problems, smoking and drinking habits, etc.) to probabilistically estimate, using actuarial or other suitable methods, the likely timing inputs and resultant disposition of the estate given a certain estate plan strategy. Further, the model optionally provides a probabilistic comparison between the alternative scenarios based on life expectancy, asset growth estimates and other probabilistic inputs.”

(Ex. 1005 [*Racanelli*] at [0068] (underlining added).)

- iv. **6[c]: wherein the one or more indications associated with the resource allocation instructions comprise the one or more scenarios associated with the one or more scenarios.**

283. *Racanelli* in view of *Bateman* renders obvious wherein the one or more indications associated with the resource allocation instructions comprise the one or more scenarios associated with the one or more scenarios [conditions].³

284. As discussed above for Claim 1[d] in **Section XII.B.2.v**, *Racanelli* in view of *Bateman* renders obvious the claimed one or more indications associated with the resource allocation instructions. I adopt that analysis here as well.

³ Based on Claim 6[b], it appears that Claim 6[c]’s “one or more scenarios associated with the one or more scenarios” is a typo that should instead read “one or more scenarios associated with the one or more conditions.”

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285. As discussed above for Claim 6[b] in **Section XII.B.6.iii**, *Racanelli* discloses one or more scenarios associated with the one or more conditions, including a both a projected asset valuation and a predicted distribution of assets. I adopt that analysis here as well.

286. *Racanelli* further discloses including its scenarios for projected asset valuations and predicted distributions of assets in flowcharts:

“These alternative timing or event input scenarios may optionally be further depicted in corresponding flow charts and liquidity analysis outputs as described elsewhere. Additional embodiments may also implement a portion or combination of the various analyses and simulations described in Figs. 12-14 to advantageously provide a wide spectrum of estate plan estimates under a variety of different circumstances involving a confluence of factors such as event timing, asset and liability allocation, and conveyance instructions.”

(Ex. 1005 [*Racanelli*] at [0069].)

* * *

“Various disclosed embodiments advantageously allow for a user, such as a wealth advisor or estate planner, to efficiently and easily customize visual representations of the disposition of a client’s estate based on various customizable circumstances. Further, disclosed embodiments allow the client to view the allocation or distribution of their assets and liabilities in their estate plan

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at a given time and under a variety of simulated circumstances.”

(Ex. 1005 [*Racanelli*] at [0084].)

7. Claim 7

i. 7[p]: The computer-implemented method of claim 6,

287. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the computer-implemented method of Claim 6, as discussed above in **Section XII.B.6.**

I adopt that analysis here as well.

ii. 7[a]: wherein the one or more conditions comprise a possible life expectancy of the one or more entities or a possible valuation of the one or more assets.

288. *Racanelli* discloses wherein the one or more conditions comprise a possible life expectancy of the one or more entities or a possible valuation of the one or more assets.

289. *Racanelli* discloses one or more conditions, as discussed above for Claim 6[a] in **Section XII.B.6.ii.** I adopt that analysis here as well.

290. *Racanelli* further discloses wherein the one or more conditions comprise a possible life expectancy of the one or more entities or a possible valuation of the one or more assets.

291. *First, Racanelli* discloses wherein the one or more conditions comprise a possible life expectancy of the one or more entities.

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292. The “one or more entities” in Claim 6 refers to “one or more entities comprising one or more resource recipients.” *Racanelli* describes a testator’s spouse as an example of a recipient of assets distributed by a will—*i.e.*, an entity comprising a resource recipient. (Ex. 1005 [*Racanelli*] at [0045]-[0046].) *Racanelli* further discloses receiving an input reflecting the life expectancy of the testator’s spouse. For example, “[t]he number of years between significant events or estimated scenarios may be input by the estate planner or estimated based, for example, on the statistical life expectancies of the client and/ or spouse.” (Ex. 1005 [*Racanelli*] at [0051].) *Racanelli* further describes a model that “receives inputs related to factors affecting the life expectancy of the client and/or spouse (for example, health problems, smoking and drinking habits, etc.) to probabilistically estimate, using actuarial or other suitable methods, the likely timing inputs and resultant disposition of the estate given a certain estate plan strategy.” (Ex. 1005 [*Racanelli*] at [0068].)

293. *Second*, *Racanelli* discloses wherein the one or more conditions comprise a possible valuation of the one or more assets.

294. *Racanelli* discloses a possible “base case” valuation of the estate’s assets as if the client were to die that day or in the current year, and the “base case” valuation is used to project the future valuation of the estate by varying timing and input events:

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“For example, the base case may run the model as if the client dies that day or in the current year. Other inputs may be the delayed death of the client and/or spouse, as well as the relative time between these deaths. Then, by varying one or more timing or event inputs (for example, illustrated schematically at 151 of Fig. 1), alternative estate disposition and liquidity estimates are generated S1403. For example, a second iteration may run the model as if the client dies in 10 years and account for the potential growth in the estate before the client’s death. This estimated growth may be estimated in a variety of methods, including but not limited to, a fixed rate of growth, an asset based rate, an actual rate, the method described in U.S. Patent No. 7,031,935 to Chhabra et al. described above, or another suitable method.”

(Ex. 1005 [*Racanelli*] at [0067].)

8. Claim 12

i. 12[p]: The computer-implemented method of claim 1,

295. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the computer-implemented method of Claim 1, as discussed above in **Section XII.B.2.**

I adopt that analysis here as well.

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- ii. **12[a]: wherein the one or more resource documents comprise one or more network policies, one or more user guides, one or more access policies, one or more authorization policies, one or more authentication policies, one or more wills, one or more trusts, a power of attorney, one or more titles, one or more deeds, one or more account resource recipient designations, one or more guardianship designations, one or more insurance policies, or one or more healthcare directives.**

296. *Racanelli* and *Bateman* each disclose wherein the one or more resource documents comprise one or more network policies, one or more user guides, one or more access policies, one or more authorization policies, one or more authentication policies, one or more wills, one or more trusts, a power of attorney, one or more titles, one or more deeds, one or more account resource recipient designations, one or more guardianship designations, one or more insurance policies, or one or more healthcare directives.

297. *Racanelli* and *Bateman* each disclose one or more resource documents, as discussed above for Claim 1[a] in **Section XII.B.2.ii**. I adopt my analysis for Claim 1[a] here as well.

298. *Racanelli* discloses both one or more wills and one or more trusts: “Estate document inputs may be retrieved from a variety of tangible or electronic records including, but not limited to, wills, codicils, revisions, amendments, revocable and irrevocable trusts, living trusts, assignments and other estate planning documents.” (Ex. 1005 [*Racanelli*] at [0048].)

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299. *Bateman* discloses both one or more wills and one or more deeds: “In some cases, the documents may be multi-page printable document format (PDF) documents that depict legally operative conveyances of interests in real property. Examples include wills, leases, deeds, easements, deeds of trust, and the like.” (Ex. 1007 [*Bateman*] at [0052].)

9. Claim 13

i. 13[p]: The computer-implemented method of claim 1,

300. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the computer-implemented method of Claim 1, as discussed above in **Section XII.B.2.**

I adopt that analysis here as well.

ii. 13[a]: wherein the generating, by the computing system, based on one or more responses and rule data comprising one or more rules associated with the resources, resource data comprising one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields, wherein the one or more resource data fields are based on the one or more resource document fields, and wherein the one or more resource data field values are based on the one or more responses comprises:

301. *Racanelli* in view of *Bateman* renders obvious wherein the generating, by the computing system, based on one or more responses and rule data comprising one or more rules associated with the resources, resource data comprising one or more resource data fields and one or more resource data field values that correspond

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to the one or more resource data fields, wherein the one or more resource data fields are based on the one or more resource document fields, and wherein the one or more resource data field values are based on the one or more responses comprises.

302. As discussed above for Claim 1[c] in **Section XII.B.2.iv**, *Racanelli* in view of *Bateman* renders obvious generating, by the computing system, based on inputting the one or more responses and rule data comprising one or more rules associated with the resources into the one or more machine-learning models, resource data comprising one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields, wherein the one or more machine-learning models are trained based on training data comprising training resource data and training rule data, and wherein the one or more resource data fields are based on the one or more resource document fields, and wherein the one or more resource data field values are based on the one or more responses. Claim 13[a] tracks Claim 1[c], except that Claim 13[a] omits certain features from Claim 1[c]. Thus, the disclosures of *Racanelli* and *Bateman* that render Claim 1[c] would also render Claim 13[a] obvious. I therefore adopt my analysis for Claim 1[c] here as well.

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- iii. **13[b]: determining, by the computing system, one or more locations associated with the one or more assets, wherein the one or more locations comprise one or more administrative divisions; and**

303. *Racanelli* in view of *Bateman* renders obvious determining, by the computing system, one or more locations associated with the one or more assets, wherein the one or more locations comprise one or more administrative divisions.

304. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system, and *Racanelli* and *Bateman* each disclose one or more assets. I adopt that analysis here as well.

305. *Bateman* discloses determining the location of real property, such as a plot of land. (Ex. 1007 [*Bateman*] at [0052], [0055].) *Bateman* discloses determining a jurisdiction (administrative division) in which that real property lies by analyzing metadata in a document that conveys that real property, such as a will. (Ex. 1007 [*Bateman*] at [0052], [0055].) For example, *Bateman* describes parsing the text of a document to determine a county in which the real property conveyed by the document is located:

“In some embodiments, each (e.g., each, or each and every) document may be associated with metadata identifying a jurisdiction in which the respective real property is located. For instance, a collection of documents pertaining to a particular plot of land may be obtained from an external source, like a third party that

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scans and hosts content acquired from a county land office by the third party, and that third party may associate the collection of documents with metadata identifying the county land office. In other cases, the metadata may be acquired from the documents themselves, for instance, by parsing such documents, matching parsed tokens to names of counties stored in a dictionary of counties, and associating the document with the name of a detected county.”

(Ex. 1007 [*Bateman*] at [0055].)

306. The '917 Patent identifies a county as an example of a location comprising an administrative division. “The one or more locations can comprise one or more administrative divisions and/or one or more organizations. The one or more administrative divisions can comprise nation states (e.g., Canada), states (e.g., Illinois, United States), provinces (e.g., Ontario, Canada), cities (e.g., Chicago), and/or counties (e.g., Cook County, Illinois).” (Ex. 1001 ['917 Patent] at 13:53-58.) The '917 Patent also identifies real property as an example of an asset. (Ex. 1001 ['917 Patent] at 6:54-64, Claim 14.) Thus, determining a county in which a real property asset is located determines a location associated with that asset, the location comprising an administrative division.

307. Finally, as discussed above in **Section XII.B.1.ii**, persons of ordinary skill in the art would have been motivated to provide *Racanelli*'s computing system

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with *Bateman*'s machine-learning-with-human-review technique for identifying conveyances of assets, including identifying the jurisdiction of a plot of land conveyed by (or that is associated with an interest conveyed by) a document. I adopt that analysis here as well. *Racanelli* in view of *Bateman* therefore renders obvious determining, by the computing system, one or more locations associated with the one or more assets, wherein the one or more locations comprise one or more administrative divisions.

iv. 13[c]: determining, by the computing system, the one or more rules associated with the one or more locations.

308. *Racanelli* in view of *Bateman* renders obvious determining, by the computing system, the one or more rules associated with the one or more locations.

309. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

310. As discussed above for Claim 1[c] in **Section XII.B.2.iv**, *Bateman* discloses one or more rules, including jurisdiction-specific ontologies governing which interests are subsets of other interests. I adopt that analysis here as well.

311. As discussed above for Claim 13[b] in **Section XII.B.9.iii**, *Racanelli* in view of *Bateman* renders obvious determining, by the computing system, one or more locations associated with the one or more assets, wherein the one or more locations comprise one or more administrative divisions, including by determining

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the jurisdiction (such as a county) in which real property sits. I adopt that analysis here as well.

312. *Bateman* further discloses selecting a jurisdiction-specific ontology of real property related rights according to the jurisdiction in which the real property sits, thus determining the one or more rules associated with the one or more locations:

“To track such rights, some embodiments may maintain in memory an ontology of real property related rights, including records of which rights are by default subsets of other rights unless explicitly reserved or conveyed. In some cases, different jurisdictions may be associated with different ontologies according to different default rules, and some embodiments may select a corresponding ontology according to the jurisdiction in which land is disposed in the course of performing analyses described herein.”

(Ex. 1007 [*Bateman*] at [0048].)

313. Finally, as discussed above in **Section XII.B.1.ii**, persons of ordinary skill in the art would have been motivated to provide *Racanelli*’s computing system with *Bateman*’s machine-learning-with-human-review technique for identifying conveyances of assets, including identifying the jurisdiction of a plot of land conveyed by (or that is associated with an interest conveyed by) a document and selecting a jurisdiction-specific ontology associated with that jurisdiction. I adopt

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that analysis here as well. *Racanelli* in view of *Bateman* therefore renders obvious determining, by the computing system, the one or more rules associated with the one or more locations

10. Claim 14

i. 14[p]: The computer-implemented method of claim 1,

314. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the computer-implemented method of Claim 1, as discussed above in **Section XII.B.2.**

I adopt that analysis here as well.

ii. 14[a]: wherein the one or more entities further comprise one or more trustees of the resources or one or more creditors, and

315. *Racanelli* discloses wherein the one or more entities further comprise one or more trustees of the resources or one or more creditors.

316. The “one or more entities” in Claim 14 refers to “one or more entities comprising one or more resource recipients.” *Racanelli* discloses resource recipients that include both (1) a trustee of the resources; and (2) a creditor. For example, *Racanelli*’s Figure 8 depicts the distribution of assets to recipients according to Jane Smith’s will, including **the distribution of NYC Home and Cash & Marketable Securities into Jane Smith’s Revocable Trust, then into (1) the Jane Smith 2001 Trusts for son Richard, daughter Janet, and daughter Julia; (2) the John and Jane Smith Foundation; and (3) a family trust.** (Ex. 1005 [*Racanelli*] at Fig. 8.)

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- iii. **14[b]: wherein the one or more assets comprise real property, tangible personal property, one or more securities, or cash.**

319. *Racanelli* and *Bateman* each disclose wherein the one or more assets comprise real property, tangible personal property, one or more securities, or cash.

320. *Racanelli* discloses various categories of assets, including “non-qualified assets, lifestyle assets, business assets and qualified assets.” (Ex. 1005 [*Racanelli*] at [0035].) It also provides specific examples of such assets, including examples corresponding to all four of Claim 14[b]’s categories of assets:

Asset in Claim 14[b]	Ex. 1005 [<i>Racanelli</i>] at [0036]
Real property	“personal residence real estate”
Tangible personal property	“tangible property (such as jewelry, art, collectables, cars, etc.)”
One or more securities	“marketable securities (such as stock, bond or other liquid holdings)”
Cash	“cash”

321. *Bateman* discloses an asset comprising real property: a plot of land. For example, *Bateman* explains that “[i]n some embodiments, each extracted conveyance record identifies one or more of a plot of land in which an interest is conveyed by the respective document, a grantor of the conveyance, a grantee of the conveyance, or the interest conveyed, and/or identifies other interest-related information of the real property.” (Ex. 1007 [*Bateman*] at [0074].)

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11. Claim 17

322. Claim 17 is the system version of Claim 1, and would have been obvious over *Racanelli* in view of *Bateman* and *Dintenfass* for similar reasons.

i. 17[p]: A computing system, comprising:

323. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

ii. 17[a]: one or more processors;

324. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system that includes one or more processors. I adopt that analysis here as well.

iii. 17[b]: one or more non-transitory computer-readable media storing instructions that, when executed by the one or more processors, cause the computing system to perform operations, the operations comprising:

325. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious one or more non-transitory computer-readable media storing instructions that, when executed by the one or more processors, cause the computing system to perform operations, the operations comprising the following features of Claim 17.

326. *Racanelli* discloses a non-transitory computer-readable medium that stores instructions for execution by a processor. *Racanelli* discloses that its computing system includes a memory that stores instructions for execution by *Racanelli*'s processor. *Racanelli* explains that its computing system has a system

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memory: “The computer system may include a general purpose computing device in the form of a computer 1501 including a processing unit 1503, a system memory 1505, and a system bus 1507 that couples various system components including the system memory to the processing unit.” (Ex. 1005 [*Racanelli*] at [0072].) *Racanelli* further explains that the system memory can include volatile and/or nonvolatile memory: “The system memory 1505 may include computer storage media in the form of volatile and/or nonvolatile memory such as read only memory (ROM) 1511 and random access memory (RAM) 1513.” (Ex. 1005 [*Racanelli*] at [0073].) Finally, *Racanelli* explains that the memory permanently or temporarily stores instructions for a processor to execute in order to implement the techniques that *Racanelli* describes:

“The memory includes at least one set of instructions that is either permanently or temporarily stored. The processor 1503 executes the instructions that are stored in order to process data. The set of instructions may include various instructions that perform a particular task or tasks, such as those shown in the appended flowcharts.”

(Ex. 1005 [*Racanelli*] at [0074].)

327. As discussed above in **Section XII.B.1.ii**, persons of ordinary skill in the art would have been motivated to combine *Racanelli*, *Bateman*, and *Dintenfass* by adding *Bateman*’s and *Dintenfass*’s functionality to *Racanelli*’s computing system. I adopt that analysis here as well. Persons of ordinary skill in the art would

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have understood that adding that functionality to *Racanelli*'s computing system would have involved storing instructions for a processor to implement *Bateman*'s and *Dintenfass*'s techniques in the memory of *Racanelli*'s computing system. Thus, *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious one or more non-transitory computer-readable media storing instructions that, when executed by the one or more processors, cause the computing system to perform the operations described in or rendered obvious by *Racanelli*, *Bateman*, and *Dintenfass*.

328. Finally, *Racanelli* in view of *Bateman* renders obvious the operations listed in Claim 17[c]-[f], and *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the operation listed in Claim 17[g], as I will discuss next.

- iv. **17[c]: generating, based on inputting one or more resource documents into one or more machine-learning models, one or more prompts comprising requests for information associated with resource allocation instructions associated with resources, wherein the one or more machine-learning models are configured to generate the one or more prompts based on recognition of textual features of the one or more resource documents associated with the resources, wherein the one or more resource documents comprise one or more resource document fields, and wherein the resource allocation instructions are associated with distribution of one or more assets of the resources to one or more entities comprising one or more resource recipients;**

329. *Racanelli* in view of *Bateman* renders obvious generating, by a computing system comprising one or more processors, based on inputting one or

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more resource documents into one or more machine-learning models, one or more prompts comprising requests for information associated with resource allocation instructions for distribution of resources, wherein the one or more machine-learning models are configured to generate the one or more prompts based on recognition of textual features of the one or more resource documents associated with the resources, wherein the one or more resource documents comprise one or more resource document fields, and wherein the resource allocation instructions are associated with distribution of one or more assets of the resources to one or more entities comprising one or more resource recipients, as I discuss above in **Section XII.B.2.ii** for Claim 1[a]. Although Claim 17[c] omits “by a computing system comprising one or more processors,” and recites “resource allocation instructions associated with resources” as opposed to “resource allocation instructions for distribution of resources,” the features of Claim 1[a] and Claim 17[c] are otherwise identical, and the disclosures that render Claim 1[a] obvious would have also rendered Claim 17[c] obvious. Thus, I adopt my analysis for Claim 1[a] here as well.

v. 17[d]: receiving one or more responses to the one or more prompts;

330. *Racanelli* in view of *Bateman* renders obvious receiving, by the computing system, one or more responses to the one or more prompts, as I discuss above in **Section XII.B.2.iii** for Claim 1[b]. Although Claim 17[d] omits “by the

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computing system,” the features of Claim 1[b] and Claim 17[d] are otherwise identical, so I adopt my analysis for Claim 1[b] here as well.

- vi. **17[e]: generating, based on inputting the one or more responses and rule data comprising one or more rules associated with the resources into the one or more machine-learning models, resource data comprising one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields, wherein the one or more machine-learning models are trained based on training data comprising training resource data and training rule data, and wherein the one or more resource data fields are based on the one or more resource document fields, and wherein the one or more resource data field values are based on the one or more responses;**

331. *Racanelli* in view of *Bateman* renders obvious generating, by the computing system, based on inputting the one or more responses and rule data comprising one or more rules associated with the resources into the one or more machine-learning models, resource data comprising one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields, wherein the one or more machine-learning models are trained based on training data comprising training resource data and training rule data, and wherein the one or more resource data fields are based on the one or more resource document fields, and wherein the one or more resource data field values are based on the one or more responses, as I discuss above in **Section XII.B.2.iv** for Claim 1[c]. Although Claim 17[e] omits “by the computing system,” the features of

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Claim 1[c] and Claim 17[e] are otherwise identical, so I adopt my analysis for Claim 1[c] here as well.

- vii. **17[f]: generating, based on the resource data, one or more indications associated with the resource allocation instructions, wherein the one or more indications comprise one or more visualizations of the distribution of the one or more assets to the one or more resource recipients; and**

332. *Racanelli* in view of *Bateman* renders obvious generating, by the computing system, based on the resource data, one or more indications associated with the resource allocation instructions, wherein the one or more indications comprise one or more visualizations of the distribution of the one or more assets to the one or more resource recipients, as I discuss above in **Section XII.B.2.v** for Claim 1[d]. Although Claim 17[f] omits “by the computing system,” the features of Claim 1[d] and Claim 17[f] are otherwise identical, so I adopt my analysis for Claim 1[d] here as well.

- viii. **17[g]: updating the one or more visualizations in real-time based on changes in one or more values of the one or more assets.**

333. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious updating, by the computing system, the one or more visualizations in real-time based on changes in one or more values of the one or more assets, as I discuss above in **Section XII.B.2.vi** for Claim 1[e]. Although Claim 17[g] omits “by the computing system,”

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the features of Claim 1[e] and Claim 17[g] are otherwise identical, so I adopt my analysis for Claim 1[e] here as well.

12. Claim 19

- i. **19[p]: One or more non-transitory computer-readable media that collectively store instructions that, when executed by one or more computing devices, cause the one or more computing devices to perform operations, the operations comprising:**

334. *Racanelli* in view of *Bateman* and *Dintenfass* render obvious one or more non-transitory computer-readable media that collectively store instructions that, when executed by one or more computing devices, cause the one or more computing devices to perform operations, the operations comprising the following features of Claim 19. Though not identical to Claim 17[b], Claim 19[p] includes substantially the same features as Claim 17[b] (including referring to the same operations) and would have been obvious over *Racanelli* in view of *Bateman* and *Dintenfass* for the same reasons that Claim 17[b] would have been obvious. Thus, I adopt my analysis for Claim 17[b] from **Section XII.B.11.iii** here as well.

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- ii. **19[a]: generating, based on inputting one or more resource documents into one or more machine-learning models, one or more prompts comprising requests for information associated with resource allocation instructions associated with resources, wherein the one or more machine-learning models are configured to generate the one or more prompts based on recognition of textual features of the one or more resource documents associated with the resources, wherein the one or more resource documents comprise one or more resource document fields, and wherein the resource allocation instructions are associated with distribution of one or more assets of the resources to one or more entities comprising one or more resource recipients;**

335. *Racanelli* in view of *Bateman* renders obvious generating, by a computing system comprising one or more processors, based on inputting one or more resource documents into one or more machine-learning models, one or more prompts comprising requests for information associated with resource allocation instructions for distribution of resources, wherein the one or more machine-learning models are configured to generate the one or more prompts based on recognition of textual features of the one or more resource documents associated with the resources, wherein the one or more resource documents comprise one or more resource document fields, and wherein the resource allocation instructions are associated with distribution of one or more assets of the resources to one or more entities comprising one or more resource recipients, as I discuss above in **Section XII.B.2.ii** for Claim 1[a]. Although Claim 19[a] omits “by a computing system comprising one

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or more processors,” and recites “resource allocation instructions associated with resources” as opposed to “resource allocation instructions for distribution of resources,” the features of Claim 1[a] and Claim 19[a] are otherwise identical, and the disclosures that render Claim 1[a] obvious would have also rendered Claim 19[a] obvious. Thus, I adopt my analysis for Claim 1[a] here as well.

iii. 19[b]: receiving one or more responses to the one or more prompts;

336. *Racanelli* in view of *Bateman* renders obvious receiving, by the computing system, one or more responses to the one or more prompts, as I discuss above in **Section XII.B.2.iii** for Claim 1[b]. Although Claim 19[b] omits “by the computing system,” the features of Claim 1[b] and Claim 19[b] are otherwise identical, so I adopt my analysis for Claim 1[b] here as well.

iv. 19[c]: generating, based on inputting the one or more responses and rule data comprising one or more rules associated with the resources into the one or more machine-learning models, resource data comprising one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields, wherein the one or more machine-learning models are trained based on training data comprising training resource data and training rule data, and wherein the one or more resource data fields are based on the one or more resource document fields, and wherein the one or more resource data field values are based on the one or more responses;

337. *Racanelli* in view of *Bateman* renders obvious generating, by the computing system, based on inputting the one or more responses and rule data

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comprising one or more rules associated with the resources into the one or more machine-learning models, resource data comprising one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields, wherein the one or more machine-learning models are trained based on training data comprising training resource data and training rule data, and wherein the one or more resource data fields are based on the one or more resource document fields, and wherein the one or more resource data field values are based on the one or more responses, as I discuss above in **Section XII.B.2.iv** for Claim 1[c]. Although Claim 19[c] omits “by the computing system,” the features of Claim 1[c] and Claim 19[c] are otherwise identical, so I adopt my analysis for Claim 1[c] here as well.

- v. **19[d]: generating, based on the resource data, one or more indications associated with the resource allocation instructions, wherein the one or more indications comprise one or more visualizations of the distribution of the one or more assets to the one or more resource recipients; and**

338. *Racanelli* in view of *Bateman* renders obvious generating, by the computing system, based on the resource data, one or more indications associated with the resource allocation instructions, wherein the one or more indications comprise one or more visualizations of the distribution of the one or more assets to the one or more resource recipients, as I discuss above in **Section XII.B.2.v** for Claim 1[d]. Although Claim 19[d] omits “by the computing system,” the features

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of Claim 1[d] and Claim 19[d] are otherwise identical, so I adopt my analysis for Claim 1[d] here as well.

- vi. **19[e]: updating the one or more visualizations in real-time based on changes in one or more values of the one or more assets.**

339. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious updating, by the computing system, the one or more visualizations in real-time based on changes in one or more values of the one or more assets, as I discuss above in **Section XII.B.2.vi** for Claim 1[e]. Although Claim 19[e] omits “by the computing system,” the features of Claim 1[e] and Claim 19[e] are otherwise identical, so I adopt my analysis for Claim 1[e] here as well.

C. Claims 3 and 8-11 would have been obvious over *Racanelli* in view of *Bateman*, *Dintenfass*, and *McMillen*.

1. Combination of *Racanelli*, *Bateman*, *Dintenfass*, and *McMillen*

- i. ***Racanelli*, *Bateman*, *Dintenfass* and *McMillen* qualify as analogous art to the ’917 Patent.**

340. As discussed above in **Section XII.B.1.i**, *Racanelli*, *Bateman*, and *Dintenfass* are analogous art to the ’917 Patent. Each reference belongs to the ’917 Patent’s field of endeavor: resource allocation. I adopt that analysis here as well.

341. *McMillen* also belongs to the ’917 Patent’s field of endeavor of resource allocation. Estate planning is an example of resource allocation, so references that belong to the field of estate planning belong to the broader field of resource

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allocation. *McMillen* belongs to the field of estate planning: “This document describes a digital platform to allow for efficient will drafting and estate planning management.” (Ex. 1010 [*McMillen*] at [0011].) Further, *McMillen* describes allocating resources in that it describes a digital will platform that permits authenticated users to allocate and reallocate assets to beneficiaries. (Ex. 1010 [*McMillen*] at [0014].)

ii. Persons of ordinary skill in the art would have been motivated to combine the teachings of *Racanelli*, *Bateman*, *Dintenfass*, and *McMillen*.

342. I previously discussed how and why persons of ordinary skill in the art would have combined the teachings of *Racanelli*, *Bateman*, and *Dintenfass* in **Section XII.B.1.ii**. I adopt that analysis here as well. In this section, I explain how and why persons of ordinary skill in the art would have combined *McMillen*’s teachings with the combined teachings of *Racanelli*, *Bateman*, and *Dintenfass*.

Persons of ordinary skill in the art would have been motivated to add *McMillen*’s machine-learning technique for projecting asset values to the combination of *Racanelli*, *Bateman*, and *Dintenfass*.

343. *Racanelli* describes techniques for projecting the value of an estate’s assets at a future date. (Ex. 1005 [*Racanelli*] at [0051], [0067].) *Racanelli* describes projecting the growth or contraction of an estate’s assets over time using any suitable method:

“The estimated growth or contraction of assets and liabilities between the death of the first and second spouses

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(or other events) may be accomplished using one or more of a variety of known methods, including probabilistic modeling techniques disclosed in U.S. Patent No. 7,031,935 to Chhabra et al., the entirety of which is incorporated by reference herewith. The number of years between significant events or estimated scenarios may be input by the estate planner or estimated based, for example, on the statistical life expectancies of the client and/ or spouse.”

(Ex. 1005 [*Racanelli*] at [0051].)

* * *

“For example, a second iteration may run the model as if the client dies in 10 years and account for the potential growth in the estate before the client’s death. This estimated growth may be estimated in a variety of methods, including but not limited to, a fixed rate of growth, an asset based rate, an actual rate, the method described in U.S. Patent No. 7,031,935 to Chhabra et al. described above, or another suitable method.”

(Ex. 1005 [*Racanelli*] at [0067].)

344. *Racanelli* describes a car as an example of a tangible asset in an estate. (Ex. 1005 [*Racanelli*] at [0036].) Persons of ordinary skill in the art would have known that for cars and other tangible assets of an estate, such as houses, jewelry, artwork, real property, and collectibles, the current condition or look of the asset is a key component of the asset’s valuation. Thus, *McMillen* describes determining an

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asset's baseline value and adjusting that baseline value using an image of the asset.

(Ex. 1010 [*McMillen*] at [0058]-[0061].) “At 408, the baseline valuation is revised based on the image. Image analysis may provide hints on the condition, size, amount, or other features of an asset.” (Ex. 1010 [*McMillen*] at [0060].)

345. The current condition of the asset is also a key component of the asset's projected future value. *McMillen* describes a car as an example of an asset whose current condition affects its future valuation. *McMillen* describes adjusting a car's baseline valuation according to images that show the car's current condition, then applying a depreciation (or appreciation) function to the adjusted baseline valuation to project asset values in subsequent years:

“Images may be used periodically (e.g., requested annually) to update the valuation. An image-based valuation may be adjusted as time continues. For instance, a vehicle may have a Bluebook value of \$5000. One or more images are provided that shows the interior and exterior of the vehicle are in excellent condition. As such, the image-based valuation is increased by 10% to \$5500. Over time, the valuation is reduced at some rate consistent with the type of asset. Here, the vehicle may be depreciated on a progressive scale of 20% after the first year, 15% per year for the next four years, and then 10% per year for the remaining years in service. The make, model, type, and other factors may be used to adjust the

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depreciation function. Further, it is understood that assets may appreciate in value, or appreciate or depreciate at different amounts or for specific reasons.”

(Ex. 1010 [*McMillen*] at [0062].)

346. To generate those projected asset valuations, *McMillen* describes using a machine learning model to both associate an image with an asset and to process data associated with the asset (including the image) to generate a valuation estimate for the asset. (Ex. 1010 [*McMillen*] at [0013], [0015].) In particular, *McMillen* describes a valuation engine configured with one or more machine learning models for estimating an asset’s value based on data associated with the asset:

“Further, the digital will platform may include an asset valuation backend engine configured to process data associated with an asset in order to generate an estimated asset value for the asset. Data associated with the asset (e.g., asset manufacturer, year of manufacture, maintenance, etc.) may be input by the user or may be automatically determined based on transaction data. A valuation engine may be configured with one or more machine learning models (e.g., CNNs, recurrent neural networks (RNNs), etc.) to process the data associated with the asset to generate a valuation estimate for the asset.”

(Ex. 1010 [*McMillen*] at [0015].)

347. Thus, *McMillen* describes projecting the future value of an asset by obtaining data about the asset’s current condition and other data, inputting that data

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into a machine learning model, determining a baseline valuation, adjusting the baseline valuation based on the asset's current condition, and applying a depreciation or appreciation function to the adjusted baseline valuation. The combination of *Racanelli's* and *McMillen's* approaches would have been natural because accurate long-term projections of asset values—as contemplated by *Racanelli*—would have necessitated a natural mechanism for assessing assets' conditions, such as the photographic analysis described by *McMillen*. Returning to the car example, the same car can have widely varying conditions that affect its value trajectory, making *McMillen's* image-based machine learning assessment a straightforward way to improve the accuracy of *Racanelli's* projections to generate realistic estate planning scenarios over multi-year or multi-decade timeframes. Persons of ordinary skill in the art therefore would have been motivated to add *McMillen's* machine-learning technique for projecting asset values to *Bateman's* machine-learning model.

Persons of ordinary skill in the art would have been motivated to add McMillen's teachings of detecting and notifying a user about life events that require changing a will to the combination of Racanelli, Bateman, and Dintenfass.

348. *McMillen* describes an online system that can detect events reflecting potential changes in assets or beneficiaries associated with a will. (Ex. 1010 [*McMillen*] at [0028], [0038]-[0039].) *McMillen's* online system can also notify a user of those events so that the user knows that the will should be updated and so that the user can update the will in light of those events—for example, by providing

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a user interface pop-up, email, or text message notification. (Ex. 1010 [*McMillen*] at [0038], [0041], [0043], [0045], [0047].)

349. *McMillen* provides those event detection and notification features because “[i]t is not uncommon to have to change or update a will” in view of various life events. (Ex. 1010 [*McMillen*] at [0028].) As *McMillen* explains,

“Many life events may cause the need to change a will such as a marital status change, a birth or death of a named or potential beneficiary, moving to a new location with different intestate laws, the acquisition or disposal of property, or the death of a named executor, or a change in tax laws, just to list a few examples.”

(Ex. 1010 [*McMillen*] at [0028].)

350. Along those lines, *Dintenfass* describes notifying users to update their estate plans based on new information, such as the death of a beneficiary or changes in law or residency. (Ex. 1009 [*Dintenfass*] at [0059], [0064].) For example, *Dintenfass* describes transmitting a notification to a user so that a user can update an estate portal application for managing a will based on new information:

“In some embodiments, the system may be configured to transmit a notification to the user indicating that the user may have to update the estate portal application based on new information. For example, the new information may include a death of a beneficiary, change in state or

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regulatory laws since the generation of the previous will,
change in the residency of the user, or the like.”

(Ex. 1009 [*Dintenfass*] at [0064].)

351. Persons of ordinary skill in the art would have recognized from *McMillen* and *Dintenfass* that keeping a will up-to-date is a necessary part of estate planning. They also would have recognized that detecting events that require changing a will and notifying a user of those events would help a user keep the will up-to-date in light of those events. For those reasons, persons of ordinary skill in the art would have been motivated to add the event detection and notification features of *McMillen*’s online system to *Racanelli*’s computing system, thereby providing a computing system that can detect events that require changing a will and notifying a user of those events so that the user can keep the will up-to-date.

iii. Persons of ordinary skill in the art would have had a reasonable expectation of success in combining the teachings of *Racanelli*, *Bateman*, *Dintenfass*, and *McMillen*.

352. Persons of ordinary skill in the art would have had a reasonable expectation of successfully combining the teachings of *Racanelli*, *Bateman*, and *Dintenfass*, as discussed above in **Section XII.B.1.iii**. They also would have had a reasonable expectation of successfully adding the teachings of *McMillen* to the teachings of *Racanelli*, *Bateman*, and *Dintenfass*.

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353. The combination of *Racanelli*, *Bateman*, *Dintenfass*, and *McMillen* that I have discussed would have entailed (1) adding, to *Bateman*'s language processing model, *McMillen*'s machine-learning techniques for projecting asset values; and (2) adding, to *Racanelli*'s computer system, programming for *McMillen*'s event detection and notification features. Persons of ordinary skill in the art would have had a reasonable expectation of successfully implementing both modifications.

354. First, persons of ordinary skill in the art would have had a reasonable expectation of successfully adding *McMillen*'s machine-learning technique for projecting asset values to *Bateman*'s language processing model. Although *Bateman*'s language processing model principally operates on text documents and *McMillen*'s machine-learning techniques for projecting asset values principally uses images to identify the condition of an asset, multimodal machine-learning models that could process both text and images were well-known and well-understood as of November 29, 2023. Examples of multimodal machine-learning systems included:

- CLIP, released by OpenAI in February 2021, which learned visual concepts from natural language supervision and could understand both images and text in a unified embedding space (Ex. 1020 [*Radford*] at 2, 27);
- Flamingo, released by DeepMind in April 2022, which could handle interleaved sequences of text and images for visual

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question answering and multimodal dialogue (Ex. 1021 [Alayrac] at 1-4);

- GPT-4, released by OpenAI in March 2023, which could accept both text and image inputs and generate text outputs, which enabled analysis of documents, photographs, diagrams, and real-world imagery (Ex. 1022 [Wiggers] at 1-3; *see also* Ex. 1016 [Liu] at 1 (describing GPT-4 as multimodal); and
- PaLM-E, released by Google in March 2023, which integrated vision and language for embodied reasoning and robotic control (Ex. 1023 [Driess] at 1).

355. Those multimodal systems demonstrated that combining text processing and image processing in a single machine-learning model or system was not only feasible but had become routine practice by mid-2023. Persons of ordinary skill in the art would have understood how to implement such combinations using established architectures, and therefore would have had a reasonable expectation of successfully adding *McMillen's* image-based machine-learning techniques for projecting asset values to *Bateman's* machine-learning model.

356. *Second*, persons of ordinary skill in the art would have had a reasonable expectation of successfully adding, to *Racanelli's* computer system, programming for *McMillen's* event detection and notification features. That combination would

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have required only routine programming knowledge well within the skill of persons of ordinary skill in the art as of November 29, 2023.

357. For those reasons, persons of ordinary skill in the art would have had a reasonable expectation of successfully combining the teachings of *Racanelli*, *Bateman*, *Dintenfass*, and *McMillen*.

2. Claim 3

i. 3[p]: The computer-implemented method of claim 2,

358. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the computer-implemented method of Claim 2, as discussed above in **Section XII.B.3**.

I adopt that analysis here as well.

ii. 3[a]: wherein the one or more machine-learning models comprise one or more machine-learning asset projection models, and

359. *Racanelli* in view of *Bateman* and *McMillen* renders obvious wherein the one or more machine-learning models comprise one or more machine-learning asset projection models.

360. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Bateman* discloses one or more machine-learning models. I adopt that analysis here as well.

361. *McMillen* describes a valuation engine configured with one or more machine learning models for estimating an asset's adjusted baseline value based on data associated with the asset, such as an image reflecting the asset's condition:

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“Further, the digital will platform may include an asset valuation backend engine configured to process data associated with an asset in order to generate an estimated asset value for the asset. Data associated with the asset (e.g., asset manufacturer, year of manufacture, maintenance, etc.) may be input by the user or may be automatically determined based on transaction data. A valuation engine may be configured with one or more machine learning models (e.g., CNNs, recurrent neural networks (RNNs), etc.) to process the data associated with the asset to generate a valuation estimate for the asset.”

(Ex. 1010 [*McMillen*] at [0015].)

* * *

“At 404, a baseline valuation is determined. The baseline valuation may be based on a manufacturer's suggested retail price (MSRP), a standard valuation (e.g., a Bluebook value), a purchase price, or the like.

At 406, a user is prompted for an image of the asset. The user may be working within a graphical user interface (GUI) on an estate planning online system, such as online system 106. The user may upload an image file that is saved on the user's computer, for instance.

At 408, the baseline valuation is revised based on the image. Image analysis may provide hints on the condition, size, amount, or other features of an asset. The valuation

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is revised and stored in a data store, such as database 110 in online system 106.”

(Ex. 1010 [*McMillen*] at [0058]-[0060].)

362. The machine learning model can use the adjusted baseline valuation and a depreciation (or appreciation) function to project the asset’s future value:

“An image-based valuation may be adjusted as time continues. For instance, a vehicle may have a Bluebook value of \$5000. One or more images are provided that shows the interior and exterior of the vehicle are in excellent condition. As such, the image-based valuation is increased by 10% to \$5500. Over time, the valuation is reduced at some rate consistent with the type of asset. Here, the vehicle may be depreciated on a progressive scale of 20% after the first year, 15% per year for the next four years, and then 10% per year for the remaining years in service. The make, model, type, and other factors may be used to adjust the depreciation function. Further, it is understood that assets may appreciate in value, or appreciate or depreciate at different amounts or for specific reasons.”

(Ex. 1010 [*McMillen*] at [0062].)

363. As discussed above in **Section XII.C.1.ii**, persons of ordinary skill in the art would have been motivated to use *McMillen*’s machine-learning techniques for projecting asset valuations to generate the projected asset valuations

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contemplated by *Racanelli*, and therefore to provide *Bateman*'s language processing model with *McMillen*'s machine-learning techniques for projecting asset valuations.

I adopt that analysis here as well. *Racanelli* in view of *Bateman* and *McMillen* therefore renders obvious wherein the one or more machine-learning models comprise one or more machine-learning asset projection models.

iii. 3[b]: wherein the projected asset valuation is based on inputting the resource data and financial data into the one or more machine-learning asset projection models that are configured to generate the projected asset valuation,

364. *Racanelli* in view of *Bateman* and *McMillen* renders obvious wherein the projected asset valuation is based on inputting the resource data and financial data into the one or more machine-learning asset projection models that are configured to generate the projected asset valuation.

365. As discussed above for Claim 1[c] in **Section XII.B.2.iv**, *Racanelli* in view of *Bateman* renders obvious the claimed resource data: data that indicates which recipients will receive which assets according to a will or other document. I adopt that analysis here as well.

366. As discussed above for Claim 2[b] in **Section XII.B.3.iii**, *Racanelli* in view of *Bateman* renders obvious a projected asset valuation based on resource data. I adopt that analysis here as well.

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367. As discussed above for Claim 3[a] in **Section XII.C.2.ii**, *Racanelli* in view of *Bateman* and *McMillen* renders obvious wherein the one or more machine-learning models comprise one or more machine-learning asset projection models. I adopt that analysis here as well. The same disclosures render obvious that the machine-learning asset projection model is configured to generate the projected asset valuation.

368. *Racanelli* in view of *Bateman* and *McMillen* renders obvious inputting resource data and financial data into the machine-learning asset projection model to generate the projected asset valuation.

369. Starting with resource data, *Racanelli* describes projecting the value of the assets of an estate. (Ex. 1005 [*Racanelli*] at [0051], [0067].) To project the value of an estate's assets, it would have been necessary to identify the estate's assets first. The resource data identifies the estate's assets. Thus, it would have been obvious to input the resource data into the *Bateman-McMillen* machine learning model for the purposes of generating projected asset valuations for the estate's assets.

370. As for financial data, Claim 3[c] explains that "financial data" includes "one or more predicted asset appreciation rates or one or more asset depreciation rates." *McMillen* discloses that its machine-learning model can project an asset's value by inputting financial data including one or more asset depreciation rates. (Ex.

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1010 [*McMillen*] at [0015], [0062].) For example, *McMillen* discloses projecting a car's valuation based on one or more asset depreciation rates:

“Over time, the valuation is reduced at some rate consistent with the type of asset. Here, the vehicle may be depreciated on a progressive scale of 20% after the first year, 15% per year for the next four years, and then 10% per year for the remaining years in service.”

(Ex. 1010 [*McMillen*] at [0062].)

371. Because *McMillen*'s machine-learning model is projecting an asset valuation based on one or more depreciation rates, persons of ordinary skill in the art would have understood that the depreciation rates were input into the machine-learning model to generate the projected asset valuation.

372. Thus, *Racanelli* in view of *Bateman* and *McMillen* renders obvious inputting both resource data (identifying the estate's assets) and financial data (such as a depreciation rate used to project an asset's future value) into the *Bateman-McMillen* machine-learning model to generate a projected asset valuation. *Racanelli* in view of *Bateman* and *McMillen* therefore renders obvious wherein the projected asset valuation is based on inputting the resource data and financial data into the one or more machine-learning asset projection models that are configured to generate the projected asset valuation.

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- iv. **3[c]: wherein the financial data comprises one or more predicted asset appreciation rates or one or more asset depreciation rates.**

373. *McMillen* discloses wherein the financial data comprises one or more predicted asset appreciation rates or one or more asset depreciation rates.

374. As discussed above for Claim 3[b] in **Section XII.C.2.iii**, *McMillen* discloses financial data. I adopt that analysis here as well.

375. *McMillen* further discloses that the financial data includes an asset depreciation rate. For example, *McMillen* discloses projecting a car's valuation based on one or more asset depreciation rates:

“Over time, the valuation is reduced at some rate consistent with the type of asset. Here, the vehicle may be depreciated on a progressive scale of 20% after the first year, 15% per year for the next four years, and then 10% per year for the remaining years in service.”

(Ex. 1010 [*McMillen*] at [0062].)

3. Claim 8

- i. **8[p]: The computer-implemented method of claim 6,**

376. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the computer-implemented method of Claim 6, as discussed above in **Section XII.B.6**. I adopt that analysis here as well.

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- ii. **8[a]: wherein the one or more machine-learning models comprise one or more machine-learning scenario models, and**

377. *Racanelli* in view of *Bateman* and *McMillen* renders obvious wherein the one or more machine-learning models comprise one or more machine-learning scenario models.

378. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Bateman* discloses one or more machine-learning models. I adopt that analysis here as well.

379. *McMillen* discloses a machine-learning scenario model. Claim 6[b] explains that an example of a scenario is a projected asset valuation, and *McMillen* describes a machine-learning model for projecting an asset valuation.

380. *McMillen* describes a valuation engine configured with one or more machine learning models for estimating an asset's adjusted baseline value based on data associated with the asset, such as an image reflecting the asset's condition:

“Further, the digital will platform may include an asset valuation backend engine configured to process data associated with an asset in order to generate an estimated asset value for the asset. Data associated with the asset (e.g., asset manufacturer, year of manufacture, maintenance, etc.) may be input by the user or may be automatically determined based on transaction data. A valuation engine may be configured with one or more machine learning models (e.g., CNNs, recurrent neural

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networks (RNNs), etc.) to process the data associated with the asset to generate a valuation estimate for the asset.”

(Ex. 1010 [*McMillen*] at [0015].)

* * *

“At 404, a baseline valuation is determined. The baseline valuation may be based on a manufacturer's suggested retail price (MSRP), a standard valuation (e.g., a Bluebook value), a purchase price, or the like.

At 406, a user is prompted for an image of the asset. The user may be working within a graphical user interface (GUI) on an estate planning online system, such as online system 106. The user may upload an image file that is saved on the user’s computer, for instance.

At 408, the baseline valuation is revised based on the image. Image analysis may provide hints on the condition, size, amount, or other features of an asset. The valuation is revised and stored in a data store, such as database 110 in online system 106.”

(Ex. 1010 [*McMillen*] at [0058]-[0060].)

381. The machine learning model can use the adjusted baseline valuation and a depreciation (or appreciation) function to project the asset’s future value:

“An image-based valuation may be adjusted as time continues. For instance, a vehicle may have a Bluebook value of \$5000. One or more images are provided that shows the interior and exterior of the vehicle are in excellent condition. As such, the image-based valuation

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is increased by 10% to \$5500. Over time, the valuation is reduced at some rate consistent with the type of asset. Here, the vehicle may be depreciated on a progressive scale of 20% after the first year, 15% per year for the next four years, and then 10% per year for the remaining years in service. The make, model, type, and other factors may be used to adjust the depreciation function. Further, it is understood that assets may appreciate in value, or appreciate or depreciate at different amounts or for specific reasons.”

(Ex. 1010 [*McMillen*] at [0062].)

382. As discussed above in **Section XII.C.1.ii**, persons of ordinary skill in the art would have been motivated to use *McMillen*’s machine-learning techniques for projecting asset valuations (scenarios) to generate the projected asset valuations contemplated by *Racanelli*, and therefore to provide *Bateman*’s language processing model with *McMillen*’s machine-learning techniques for projecting asset valuations. I adopt that analysis here as well. *Racanelli* in view of *Bateman* and *McMillen* therefore renders obvious wherein the one or more machine-learning models comprise one or more machine-learning scenario models.

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- iii. **8[b]: wherein the determining the one or more scenarios is based on inputting the resource data and the one or more conditions into the one or more machine-learning scenario models that are configured to generate the one or more scenarios.**

383. *Racanelli* in view of *Bateman* and *McMillen* renders obvious wherein the determining the one or more scenarios is based on inputting the resource data and the one or more conditions into the one or more machine-learning scenario models that are configured to generate the one or more scenarios.

384. As discussed above for Claim 1[c] in **Section XII.B.2.iv**, *Racanelli* in view of *Bateman* renders obvious the claimed resource data: data that indicates which recipients will receive which assets according to a will or other document. I adopt that analysis here as well.

385. As discussed above for Claim 6[b] in **Section XII.B.6.iii**, *Racanelli* in view of *Bateman* renders obvious determining a projected asset valuation (scenario) based on one or more conditions, including a “base-case” valuation of the assets and a growth rate. I adopt that analysis here as well.

386. As discussed above for Claim 8[a] in **Section XII.C.3.ii**, *Racanelli* in view of *Bateman* and *McMillen* renders obvious wherein the one or more machine-learning models comprise one or more machine-learning scenario models. I adopt that analysis here as well. The same disclosures render obvious that the machine-learning scenario model is configured to generate a scenario.

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387. *Racanelli* in view of *Bateman* and *McMillen* renders obvious inputting resource data and one or more conditions into the machine-learning scenario model to determine/generate a scenario.

388. Starting with resource data, *Racanelli* describes projecting the value of the assets of an estate. (Ex. 1005 [*Racanelli*] at [0051], [0067].) To project the value of an estate's assets, it would have been necessary to identify the estate's assets first. The resource data identifies the estate's assets. Thus, it would have been obvious to input the resource data into the *Bateman-McMillen* machine learning model to determine/generate a scenario reflecting a projected asset valuation.

389. As for one or more conditions, *Racanelli* in view of *Bateman* renders obvious determining a projected asset valuation (scenario) based on conditions reflecting a "base-case" valuation of the assets and a growth rate, as discussed for Claim 6[b] in **Section XII.B.6.iii**. *McMillen* describes a machine-learning technique for projecting asset values that uses similar inputs: an asset's adjusted baseline valuation and depreciation rates, which are simply negative growth rates. (Ex. 1010 [*McMillen*] at [0015], [0058]-[0060], [0062].)

390. It would have been obvious to input the base-case valuation of the estate's assets and a growth rate (such as a depreciation rate)—the conditions—into the *Bateman-McMillen* machine-learning model so as to take advantage of *McMillen*'s machine-learning technique for adjusting baseline asset values based on

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the conditions of the assets, then projecting an asset valuation using a growth rate (such as a depreciation rate). As I discuss above in **Section XII.C.1.ii** and adopt here as well, persons of ordinary skill in the art would have recognized that *McMillen*'s machine-learning technique would have been expected to yield more accurate asset-value projections because it takes the current conditions of the assets into account, which in turn affect the future values of the assets.

391. In sum, *Racanelli* in view of *Bateman* and *McMillen* renders obvious inputting resource data (identifying the estate's assets) and a base-case valuation of those assets and a growth rate such as a depreciation rate (conditions) into the *Bateman-McMillen* machine-learning model to generate an asset value projection (scenario). Thus, *Racanelli* in view of *Bateman* and *McMillen* renders obvious wherein the determining the one or more scenarios is based on inputting the resource data and the one or more conditions into the one or more machine-learning scenario models that are configured to generate the one or more scenarios.

4. Claim 9

i. **9[p]: The computer-implemented method of claim 1, further comprising:**

392. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the computer-implemented method of Claim 1, as discussed above in **Section XII.B.2**. I adopt that analysis here as well.

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- ii. **9[a]: receiving, by the computing system, event data comprising information associated with a plurality of events associated with the resources;**

393. *Racanelli* in view of *McMillen* renders obvious receiving, by the computing system, event data comprising information associated with a plurality of events associated with the resources.

394. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

395. *McMillen* discloses receiving event data comprising information associated with a plurality of events associated with the resources. *McMillen* discloses an online system that receives information associated with a plurality of events such as a marital status change, the acquisition of property, birth of a beneficiary, or death of a named beneficiary by detecting those events:

“It is not uncommon to have to change or update a will. Many life events may cause the need to change a will such as a marital status change, a birth or death of a named or potential beneficiary, moving to a new location with different intestate laws, the acquisition or disposal of property, or the death of a named executor, or a change in tax laws, just to list a few examples. These life events may be detected by the online system 106 using systems and techniques described herein. In particular, the online system 106 is able to detect potential new beneficiaries or

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new assets by analyzing transactional histories of the user 102.”

(Ex. 1010 [*McMillen*] at [0028].)

396. As a specific example of detecting a marital status change, *McMillen* discloses detecting a wedding, which reflects that a beneficiary has become married.

(Ex. 1010 [*McMillen*] at [0039], [0055].)

397. Similarly, *McMillen* describes that its online system can interface with various data sources to identify events (e.g., purchases or sales) and other information that may reflect changes in assets and beneficiaries:

“By interfacing with one or more of these systems 112-126, the online system 106 is able to gather a broad spectrum of information about the user 102 including past purchases or sales, intended or planned future purchases or sales, income and debt levels, occupation and social circles, family demographics, spending and saving trends, travel and interests, political and religious affiliations, and more. Using this information, the online system 106 is able to identify potential changes in assets or beneficiaries.”

(Ex. 1010 [*McMillen*] at [0038].)

398. *McMillen* also describes that its online system obtains transaction data (event data) that includes information associated with a plurality of events:

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“By interfacing with one or more of these systems 112-126, the online system 106 is able to gather a broad spectrum of information about the user 102 including past purchases or sales, intended or planned future purchases or sales, income and debt levels, occupation and social circles, family demographics, spending and saving trends, travel and interests, political and religious affiliations, and more.”

(Ex. 1010 [*McMillen*] at [0038].)

* * *

“At operation 202, transaction data from one or more data sources is analyzed to identify trigger events. The data source may include systems, such as a banking system 112, brokerage system 114, insurance system 116, credit bureau system 118, tax and revenue system 120, or title and licensing system 122 discussed in FIG. 1. . . . Transaction data may include data related to any type of transaction, such as financial transactions, which may include buying goods or services, selling property, posting for an asset for sale, searching for a rental property, donating to a charity, depositing money into an account, establishing an insurance policy, or the like; or social transactions, which may include establishing or terminating a relationship on a social media platform, posting a birth announcement, posting a photo of a wedding, or the like.”

(Ex. 1010 [*McMillen*] at [0039].)

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* * *

“At 304, transaction data is obtained from one or more sources. The transaction data may of any type of data, such as a bank statement, a real-time stock feed from a brokerage firm, a quarterly summary from a credit card issuer, or the like.”

(Ex. 1010 [*McMillen*] at [0051].)

399. The events that *McMillen*’s online system detects are associated with the resources in that they relate to a resource (e.g., the acquisition of an asset) or to a recipient of a resource (e.g., the birth or death of a named beneficiary, or the establishment or termination of a relationship). (Ex. 1010 [*McMillen*] at [0028], [0038]-[0039], [0050]-[0052], [0055].) Indeed, *McMillen* describes analyzing those events to identify “trigger events” related to an asset or to a beneficiary: “Trigger events may be classified into various categories, such as ‘potential asset acquisition’, ‘potential asset disposition’, ‘potential addition of beneficiary’, or ‘potential removal of beneficiary’.” (Ex. 1010 [*McMillen*] at [0052].)

400. Finally, as discussed above in **Section XII.C.1.ii**, persons of ordinary skill in the art would have been motivated to add the event detection and notification features of *McMillen*’s online system to *Racanelli*’s computing system. I adopt that analysis here as well. *Racanelli* in view of *McMillen* therefore renders obvious receiving, by the computing system, event data comprising information associated with a plurality of events associated with the resources.

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- iii. **9[b]: determining, by the computing system, based on the resource data, whether one or more events of the plurality of events satisfy one or more event criteria; and**

401. *Racanelli* in view of *Bateman* and *McMillen* renders obvious determining, by the computing system, based on the resource data, whether one or more events of the plurality of events satisfy one or more event criteria.

402. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

403. As discussed above for Claim 1[c] in **Section XII.B.2.iv**, *Racanelli* in view of *Bateman* renders obvious the claimed resource data: data that indicates which recipients will receive which assets according to a will or other document. I adopt that analysis here as well.

404. As discussed above for Claim 9[a] in **Section XII.C.4.ii**, *Racanelli* in view of *McMillen* renders obvious receiving, by the computing system, event data comprising information associated with a plurality of events associated with the resources. I adopt that analysis here as well.

405. *McMillen* discloses that its online system analyzes the event data that it receives to identify “trigger events” that might require a change in the assets or beneficiaries of an existing will. (Ex. 1010 [*McMillen*] at [0038]-[0039], [0052].) For example, *McMillen* describes that “transaction data from one or more data sources is analyzed to identify trigger events.” (Ex. 1010 [*McMillen*] at [0039].) A

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model can be trained to identify trigger events based on transaction data: “FIG. 3 is a flowchart illustrating a method 300 for identifying trigger events, according to an embodiment. At 302, a model is trained based on transaction data. The model may be specific to detect or infer assets or beneficiaries from the transaction data.” (Ex. 1010 [*McMillen*] at [0050].) Transaction data is obtained and used with the model to identify a trigger event. (Ex. 1010 [*McMillen*] at [0051]-[0052].) “Trigger events may be classified into various categories, such as ‘potential asset acquisition’, ‘potential asset disposition’, ‘potential addition of beneficiary’, or ‘potential removal of beneficiary’.” (Ex. 1010 [*McMillen*] at [0052].)

406. Thus, *McMillen* describes that its online system determines whether the event data that it has received satisfies the criterion of being a “trigger event” that reflects a potential change in assets or beneficiaries. Determining whether a change in assets or beneficiaries is required, in turn, would have required information about the current assets and beneficiaries—which is reflected in the resource data that indicates which recipients will receive which assets according to a will or other document, as discussed above for Claim 1[c] in **Section XII.B.2.iv**. It therefore would have been obvious to use that resource data to determine whether an event detected according to *McMillen*’s teachings qualifies as a “trigger event” that could require changing the assets and beneficiaries of a will. Thus combined, *McMillen*’s teaching of detecting a trigger event that might require changing the assets and

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beneficiaries reflected in the “resource data” generated according to *Racanelli* and *Bateman* “determin[es] . . . based on the resource data, whether one or more events of the plurality of events satisfy one or more event criteria.”

407. Finally, as discussed above in **Section XII.C.1.ii**, persons of ordinary skill in the art would have been motivated to add the event detection and notification features of *McMillen*’s online system to *Racanelli*’s computing system. I adopt that analysis here as well. Thus, *Racanelli* in view of *Bateman* and *McMillen* renders obvious determining, by the computing system, based on the resource data, whether one or more events of the plurality of events satisfy one or more event criteria.

iv. 9[c]: generating, by the computing system, one or more event notifications associated with the one or more events that satisfy the one or more event criteria,

408. *Racanelli* in view of *Bateman* and *McMillen* renders obvious generating, by the computing system, one or more event notifications associated with the one or more events that satisfy the one or more event criteria.

409. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

410. As discussed above for Claim 9[b] in **Section XII.C.4.iii**, *Racanelli* in view of *Bateman* and *McMillen* renders obvious one or more events that satisfy the one or more event criteria. I adopt that analysis here as well.

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411. *McMillen* discloses generating one or more event notifications associated with the one or more events that satisfy the one or more event criteria. In particular, *McMillen* describes generating a notification about a trigger event that reflects a potential change in assets or beneficiaries: “Using this information, the online system 106 is able to identify potential changes in assets or beneficiaries. After identifying these potential changes, the online system 106 may notify the user 102, update one or more elements of a will, update a will, or perform other operations as discussed herein.” (Ex. 1010 [*McMillen*] at [0038].) Notifications for the potential addition or removal of an asset or beneficiary can be generated. (Ex. 1010 [*McMillen*] at [0041], [0043], [0045], [0047].) *McMillen* further describes providing the event notification as an email, text message, or user interface pop-up. (Ex. 1010 [*McMillen*] at [0041], [0043], [0045], [0047].) Three examples of notifications are shown below in *McMillen*’s Figure 5, reference number 506:



412. Finally, as discussed above in **Section XII.C.1.ii**, persons of ordinary skill in the art would have been motivated to add the event detection and notification features of *McMillen*'s online system to *Racanelli*'s computing system. I adopt that analysis here as well.

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- v. **9[d]: wherein the one or more indications associated with the resource allocation instructions comprise the one or more event notifications.**

413. *Racanelli* in view of *Bateman* and *McMillen* renders obvious wherein the one or more indications associated with the resource allocation instructions comprise the one or more event notifications.

414. As discussed above for Claim 1[d] in **Section XII.B.2.v**, *Racanelli* in view of *Bateman* renders obvious the claimed one or more indications associated with the resource allocation instructions. I adopt that analysis here as well.

415. As discussed above for Claim 9[c] in **Section XII.C.4.iv**, *Racanelli* in view of *Bateman* and *McMillen* renders obvious one or more event notifications associated with the one or more events that satisfy the one or more event criteria. As discussed, those event notifications can include an email, text message, or user interface pop-up. (Ex. 1010 [*McMillen*] at [0041], [0043], [0045], [0047].) I adopt that analysis here as well.

416. Persons of ordinary skill in the art would have been motivated to include *McMillen*'s user interface pop-ups with the flowcharts generated according to *Racanelli* and *Bateman*. That way, the user could see the current assets and beneficiaries along with notification about the asset or beneficiary that may require updating—a feature that Figure 5 of *McMillen* suggests, as shown below:



(Ex. 1010 [*McMillen*] at Fig. 5.)

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5. Claim 10

i. 10[p]: The computer-implemented method of claim 9, further comprising:

418. *Racanelli* in view of *Bateman*, *Dintenfass*, and *McMillen* renders obvious the computer-implemented method of Claim 9, as discussed above in **Section XII.C.4**. I adopt that analysis here as well.

ii. 10[a]: sending, by the computing system, the one or more event notifications to one or more remote computing devices associated with an entity that is authorized to receive the one or more event notifications.

419. *Racanelli* in view of *Bateman* and *McMillen* renders obvious sending, by the computing system, the one or more event notifications to one or more remote computing devices associated with an entity that is authorized to receive the one or more event notifications.

420. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

421. As discussed above for Claim 9[c] in **Section XII.C.4.iv**, *Racanelli* in view of *Bateman* and *McMillen* renders obvious one or more event notifications associated with the one or more events that satisfy the one or more event criteria. I adopt that analysis here as well.

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422. *McMillen* discloses or at least renders obvious sending an event notification to a remote computing device associated with an entity that is authorized to receive the one or more event notifications.

423. To start, *McMillen* discloses a remote computing device: a user device. *McMillen* describes that a user can access an online system 106 via the user's user device 104, such as a smartphone or mobile device. (Ex. 1010 [*McMillen*] at [0018].) *McMillen* further describes that the user device can connect to the online system over a network such as a wide-area network, a cellular network, or the Internet, among other types of networks. (Ex. 1010 [*McMillen*] at Fig. 1, [0020].) A user device connected to the online system over a wide-area network, cellular network, or the Internet is a remote computing device in that it is a computing device that is not on the same local network as the online system.

424. *McMillen* further discloses or at least renders obvious that its online system sends an event notification to a user device (remote computing device) associated with an entity authorized to receive event notifications. As discussed, *McMillen* discloses a user accessing an online system via the user's user device, a remote computing device associated with the user. (Ex. 1010 [*McMillen*] at [0018].) "The user 102 may be the testator or another person who is authorized to make changes to the testator's will." (Ex. 1010 [*McMillen*] at [0027].) *McMillen* describes that the user may log into the online system on the user device to access the user's

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account. (Ex. 1010 [*McMillen*] at [0018], [0027].) *McMillen* also describes that the online system sends event notifications to the user device as a text message, email, or user interface pop-up. (Ex. 1010 [*McMillen*] at [0038], [0041], [0043], [0045], [0047], [0081], [0088]-[0090].) Persons of ordinary skill in the art would have recognized that a user logged in to *McMillen*'s online system is authorized to receive event notifications in that (1) the user is authorized to make changes to the testator's will; and (2) the user has been authenticated by logging in to the online system, the source of those event notifications.

425. Finally, as discussed above in **Section XII.C.1.ii**, persons of ordinary skill in the art would have been motivated to add the event detection and notification features of *McMillen*'s online system to *Racanelli*'s computing system. I adopt that analysis here as well. *Racanelli* in view of *Bateman* and *McMillen* therefore renders obvious sending, by the computing system, the one or more event notifications to one or more remote computing devices associated with an entity that is authorized to receive the one or more event notifications.

6. Claim 11

i. 11[p]: The computer-implemented method of claim 9,

426. *Racanelli* in view of *Bateman*, *Dintenfass*, and *McMillen* renders obvious the computer-implemented method of Claim 9, as discussed above in **Section XII.C.4**. I adopt that analysis here as well.

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- ii. **11[a]: wherein the plurality of events comprise marriage, divorce, receipt of a new asset, birth of a child, or death of at least one of the one or more entities.**

427. *Racanelli* in view of *McMillen* renders obvious wherein the plurality of events comprise marriage, divorce, receipt of a new asset, birth of a child, or death of at least one of the one or more entities.

428. As discussed above in **Section XII.C.4.ii**, *Racanelli* in view of *McMillen* renders obvious receiving, by the computing system, event data comprising information associated with a plurality of events associated with the resources. I adopt that analysis here as well.

429. *McMillen* discloses receiving event data about a plurality of events such as a marital status change (marriage or divorce), the acquisition of property (receipt of a new asset), birth of a beneficiary (birth of a child), or death of a named beneficiary (death of an entity):

“It is not uncommon to have to change or update a will. Many life events may cause the need to change a will such as a marital status change, a birth or death of a named or potential beneficiary, moving to a new location with different intestate laws, the acquisition or disposal of property, or the death of a named executor, or a change in tax laws, just to list a few examples. These life events may be detected by the online system 106 using systems and techniques described herein. In particular, the online

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system 106 is able to detect potential new beneficiaries or new assets by analyzing transactional histories of the user 102.”

(Ex. 1010 [*McMillen*] at [0028].)

430. As a specific example of a marital status change, *McMillen* discloses detecting a wedding, which reflects that a beneficiary has become married. (Ex. 1010 [*McMillen*] at [0039], [0055].) More generally, persons of ordinary skill in the art (and, indeed, laypersons) would have known that a “marital status change” includes marriage (becoming married) and divorce (becoming unmarried).

431. As further examples, *McMillen* describes detecting buying an asset (associated with receipt of a new asset), a wedding photo (associated with a marriage), and a birth announcement (associated with a birth of a child):

“Transaction data may include data related to any type of transaction, such as financial transactions, which may include buying goods or services, selling property, posting for an asset for sale, searching for a rental property, donating to a charity, depositing money into an account, establishing an insurance policy, or the like; or social transactions, which may include establishing or terminating a relationship on a social media platform, posting a birth announcement, posting a photo of a wedding, or the like.”

(Ex. 1010 [*McMillen*] at [0039].)

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D. Claims 15, 16, 18, and 20 would have been obvious over *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak*.

1. Combination of *Racanelli*, *Bateman*, *Dintenfass*, and *Kwak*

i. *Racanelli*, *Bateman*, *Dintenfass* and *Kwak* qualify as analogous art to the '917 Patent.

432. As discussed above in **Section XII.B.1.i**, *Racanelli*, *Bateman*, and *Dintenfass* are analogous art to the '917 Patent. Each reference belongs to the '917 Patent's field of endeavor: resource allocation. I adopt that analysis here as well.

433. *Kwak* also belongs to the '917 Patent's field of endeavor of resource allocation. Estate planning is an example of resource allocation, so references that belong to the field of estate planning belong to the broader field of resource allocation. *Kwak* belongs to the field of estate planning in that *Kwak* describes a technique for using natural language inference to assess the validity of the provisions of a will, which is an estate planning document. (Ex. 1011 [*Kwak*] at 1.)

ii. Persons of ordinary skill in the art would have been motivated to combine the teachings of *Racanelli*, *Bateman*, *Dintenfass*, and *Kwak*.

434. I previously discussed how and why persons of ordinary skill in the art would have combined the teachings of *Racanelli*, *Bateman*, and *Dintenfass* in **Section XII.B.1.ii**. I adopt that analysis here as well. In this section, I explain how and why persons of ordinary skill in the art would have combined *Kwak*'s teachings with the combined teachings of *Racanelli*, *Bateman*, and *Dintenfass*.

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Persons of ordinary skill in the art would have been motivated to provide Bateman's machine-learning model with Dintenfass's and Kwak's techniques for assessing whether provisions of a will are valid under state law.

435. Persons of ordinary skill in the art would have known that provisions of a will may be legally invalid. For example, *Kwak* describes that provisions of a will may be valid or invalid under state law given certain conditions. (Ex. 1011 [*Kwak*] at 1-2.) *Dintenfass* explains that certain asset allocations in a will, such as omitting certain beneficiaries from an estate, may be prohibited under state law:

“Typically, a will has the same function regardless of the user's state of residence, but may be subjected to variations by state. For example, a will cannot require an heir to commit an illegal, immoral, or other act against public policy as a condition of receiving an inheritance. Similarly, some states have laws against omitting certain beneficiaries from an estate, such as a surviving spouse.”

(Ex. 1009 [*Dintenfass*] at [0057].)

436. *Kwak* explains that legally invalid will provisions can make the process of processing a will more time-consuming and more expensive: “Processing a will via probate is a costly, time-consuming process that can be exacerbated by errors or by challenges to validity.” (Ex. 1011 [*Kwak*] at 1.)

437. Because of the problems that legally invalid will provisions can bring, persons of ordinary skill in the art would have sought to improve existing estate planning systems by adding techniques to assess whether provisions of a will are

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legally valid. *Kwak* and *Dintenfass* both describe the benefits of assessing whether provisions of a will are legally valid—for example, to ensure that the will is legally valid. *Kwak* states that “[d]eveloping natural language techniques that can determine a will’s validity at creation and execution can increase validity, conserve legal resources, and effectuate the author’s intent.” (Ex. 1011 [*Kwak*] at 1.) *Dintenfass* describes the benefit of taking laws and regulations into account so that a will’s provisions are legally valid: “the system takes into account the state laws and regulations for the effective and accurate generation of the will draft.” (Ex. 1009 [*Dintenfass*] at [0057].)

438. *Dintenfass* and *Kwak* also teach identifying legally invalid will provisions based on input state law. *Dintenfass* describes a technique for retrieving current state laws, identifying a discrepancy between the state law and the asset allocations in a will, and notifying the user of the discrepancy. (Ex. 1009 [*Dintenfass*] at [0057], [0059].) *Kwak* describes that natural-language inference (NLI) machine-learning models “can be employed to evaluate the validity of will statements” under state laws and factual conditions. (Ex. 1011 [*Kwak*] at 1.) “We trained multiple NLI models with our dataset to assess their performance: four transformer models and four sentence-transformer models.” (Ex. 1011 [*Kwak*] at 4.) The dataset input into the NLI models includes the will provisions to be assessed; state laws; and factual conditions. (Ex. 1011 [*Kwak*] at 1.)

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439. As I have previously discussed, *Bateman* describes a language processing model that can identify conveyances (provisions that allocate assets to recipients) in a will. (Ex. 1007 [*Bateman*] at [0051]-[0052], [0063], [0072], [0074], [0108].) Given the benefits of assessing whether a will's provisions are legally valid, persons of ordinary skill in the art would have been motivated to add *Dintenfass's* and *Kwak's* techniques for determining whether a will provision is valid based on data reflecting state law to *Bateman's* language processing model so that the model could identify whether the conveyances it has identified are legally valid.

Persons of ordinary skill in the art would have been motivated to include Dintenfass's techniques for receiving information about a change in law, retrieving current state law, and notifying a user of a change in law that requires changing a will in the combination of Racanelli, Bateman, Dintenfass, and Kwak.

440. Persons of ordinary skill in the art would have known that changes in law can require updating a will. *Dintenfass* explains that a "change in state or regulatory laws since the generation of the previous will" may require the user to update an estate portal application for generating a will. (Ex. 1009 [*Dintenfass*] at [0064].) Similarly, *McMillen* explains that "[m]any life events may cause the need to change a will," such as "moving to a new location with different intestate laws" or "a change in tax laws." (Ex. 1010 [*McMillen*] at [0028].) Because changes in law can require updating a will, persons of ordinary skill in the art would have sought to improve estate planning systems by adding features for identifying changes in

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law, determining whether those changes in law require updating a will, and notifying a user to update a will based on a change in law. *Dintenfass* describes those features.

441. *Dintenfass* describes a computer system receiving new information about a change in law. “In some embodiments, the system may be configured to transmit a notification to the user indicating that the user may have to update the estate portal application based on new information,” such as a “change in state or regulatory laws since the generation of the previous will.” (Ex. 1009 [*Dintenfass*] at [0064].) Persons of ordinary skill in the art would have inferred that because the system transmitted a notification “indicating that the user may have to update the estate portal application based on new information” such as a change in laws, the system would have received the new information that prompted the notification.

442. *Dintenfass* also describes a computer system retrieving current state law to determine whether a provision in a will is legally valid and alert the user if there is a discrepancy between the provision of the will and the current state law:

“In some instances, the system may be configured to generate an alert when there is a conflict between the state law and the asset allocation. In some embodiments, the system may be configured to trigger the will generation application on the user input system (e.g., computer, mobile device, or the like of the user) to initiate the display of the alert, thereby indicating to the user that there's a discrepancy between the current asset allocation and the

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state laws. In one aspect, the system may be configured to retrieve current state laws and accurately identify the discrepancy. In some embodiments, in response to identifying the discrepancy, the system may provide recommendations to help the user rectify the discrepancy.”

(Ex. 1009 [*Dintenfass*] at [0059].)

443. *Dintenfass* also discloses a computer system notifying a user to update a will based on a change in law. “In some embodiments, the system may be configured to transmit a notification to the user indicating that the user may have to update the estate portal application based on new information,” such as a “change in state or regulatory laws since the generation of the previous will.” (Ex. 1009 [*Dintenfass*] at [0064].)

444. Thus, persons of ordinary skill in the art would have sought to include *Dintenfass*’s techniques for identifying changes in law, determining whether those changes in law require updating a will, and notifying a user to update a will based on a change in law with the combination of *Racanelli*, *Bateman*, *Dintenfass*, and *Kwak*, and would have configured *Racanelli*’s computer system with those features.

iii. Persons of ordinary skill in the art would have had a reasonable expectation of success in combining the teachings of *Racanelli*, *Bateman*, *Dintenfass*, and *Kwak*.

445. Persons of ordinary skill in the art would have had a reasonable expectation of successfully combining the teachings of *Racanelli*, *Bateman*, and

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Dintenfass, as discussed above in **Section XII.B.1.iii**. They also would have had a reasonable expectation of successfully adding the teachings of *Kwak* to the teachings of *Racanelli*, *Bateman*, and *Dintenfass*.

446. The combination of *Racanelli*, *Bateman*, *Dintenfass*, and *Kwak* that I have discussed would have entailed (1) configuring *Bateman*'s machine-learning model to assess the validity of provisions of a will based on data reflecting state law according to *Kwak* and *Dintenfass*'s teachings; and (2) adding programming to *Racanelli*'s computer system to implement *Dintenfass*'s techniques for identifying changes in law, determining whether those changes in law require updating a will, and notifying a user to update a will based on a change in law. Persons of ordinary skill in the art would have had a reasonable expectation of successfully implementing both modifications.

447. *First*, persons of ordinary skill in the art would have had a reasonable expectation of successfully configuring *Bateman*'s machine-learning model to assess the validity of provisions of a will based on data reflecting state law according to *Kwak* and *Dintenfass*'s teachings. *Kwak* describes in detail how to train a machine-learning model to assess the validity of a will under state law and given factual conditions, including a detailed description of training data and how to annotate that training data. (Ex. 1011 [*Kwak*] at 3-4.) *Kwak* also used off-the-shelf

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machine-learning transformer models and sentence-transformer models that would have been familiar to persons of ordinary skill in the art. (Ex. 1011 [*Kwak*] at 4-5.)

448. *Kwak* also reports that the trained models performed satisfactorily: “Overall, the models demonstrated good performances. Each achieved more than 80% in all metrics but group accuracy. Roberta-large-mnli showed the best performance.” (Ex. 1011 [*Kwak*] at 5.) While recommending human-in-the-loop review to improve the performance of the trained models, *Kwak* nonetheless reports that “[t]he NLI models trained on our dataset showed reasonable performance in assessing the validity of will statements.” (Ex. 1011 [*Kwak*] at 9.)

449. *Second*, persons of ordinary skill in the art would have had a reasonable expectation of successfully adding programming to *Racanelli*’s computer system to implement *Dintenfass*’s techniques for identifying changes in law, determining whether those changes in law require updating a will, and notifying a user to update a will based on a change in law. Adding that programming to *Racanelli*’s computing system would have required only routine programming knowledge well within the skill of persons of ordinary skill in the art as of November 29, 2023.

450. For those reasons, persons of ordinary skill in the art would have had a reasonable expectation of successfully combining the teachings of *Racanelli*, *Bateman*, *Dintenfass*, and *Kwak*.

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2. Claim 15

i. 15[p]: The computer-implemented method of claim 1,

451. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the computer-implemented method of Claim 1, as discussed above in **Section XII.B.2.**

I adopt that analysis here as well.

ii. 15[a]: wherein the one or more rules are based on one or more regulations associated with the resources, and further comprising:

452. *Bateman* in view of *Dintenfass* and *Kwak* renders obvious wherein the one or more rules are based on one or more regulations associated with the resources.

453. *Bateman* discloses rule data comprising one or more rules, as discussed above for Claim 1[c] in **Section XII.B.2.iv.** I adopt that analysis here as well.

454. *Dintenfass* and *Kwak* each disclose wherein the one or more rules are based on one or more regulations associated with the resources.

455. *Dintenfass* discloses regulations associated with resources in that it describes state laws associated with the allocation of assets under a will:

“Typically, a will has the same function regardless of the user’s state of residence, but may be subjected to variations by state. For example, a will cannot require an heir to commit an illegal, immoral, or other act against public policy as a condition of receiving an inheritance.

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Similarly, some states have laws against omitting certain beneficiaries from an estate, such as a surviving spouse.”

(Ex. 1009 [*Dintenfass*] at [0057].)

* * *

“In some instances, the system may be configured to generate an alert when there is a conflict between the state law and the asset allocation. In some embodiments, the system may be configured to trigger the will generation application on the user input system (e.g., computer, mobile device, or the like of the user) to initiate the display of the alert, thereby indicating to the user that there's a discrepancy between the current asset allocation and the state laws. In one aspect, the system may be configured to retrieve current state laws and accurately identify the discrepancy. In some embodiments, in response to identifying the discrepancy, the system may provide recommendations to help the user rectify the discrepancy.”

(Ex. 1009 [*Dintenfass*] at [0059].)

456. *Kwak* discloses regulations associated with resources in that it describes state laws associated with provisions of a will, such as Tennessee state law. (Ex. 1011 [*Kwak*] at 2-3.) Wills allocate resources, so state law associated with provisions of a will are associated with resources.

457. As discussed above in **Section XII.D.1.ii**, persons of ordinary skill in the art would have been motivated to combine *Bateman* with *Dintenfass* and *Kwak*

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so that *Bateman*'s language processing model could identify whether conveyances are legally valid based on input state law. I adopt that analysis here as well. *Bateman* in view of *Dintenfass* and *Kwak* therefore renders obvious wherein the one or more rules are based on one or more regulations associated with the resources.

iii. 15[b]: receiving, by the computing system, data associated with one or more modifications of the one or more regulations;

458. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious receiving, by the computing system, data associated with one or more modifications of the one or more regulations.

459. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

460. As discussed above for Claim 15[a] in **Section XII.D.2.ii**, *Bateman* in view of *Dintenfass* and *Kwak* renders obvious one or more regulations. I adopt that analysis here as well.

461. *Dintenfass* discloses receiving data associated with one or more modifications of one or more regulations. For example, *Dintenfass* describes receiving "new information" about changes in state law that require updating a will: "In some embodiments, the system may be configured to transmit a notification to the user indicating that the user may have to update the estate portal application based on new information," such as a "change in state or regulatory laws since the

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generation of the previous will.” (Ex. 1009 [*Dintenfass*] at [0064].) Persons of ordinary skill in the art would have recognized that because the system transmitted a notification “indicating that the user may have to update the estate portal application based on new information” such as a change in laws, the system would have received the new information about the change in law that prompted the notification.

462. *Dintenfass* also discloses receiving updated state laws reflecting a modification of the laws. As discussed, *Dintenfass* describes that changes in law can require updating a will. (Ex. 1009 [*Dintenfass*] at [0064].) *Dintenfass* also describes that its system retrieves current state law to identify discrepancies between a will’s asset allocations and the current state law: “In one aspect, the system may be configured to retrieve current state laws and accurately identify the discrepancy. In some embodiments, in response to identifying the discrepancy, the system may provide recommendations to help the user rectify the discrepancy.” (Ex. 1009 [*Dintenfass*] at [0059].) Persons of ordinary skill in the art would have recognized that if the law had changed since the previous generation of the will, retrieving current state law would have retrieved the changed law—in other words, data associated with modifications of the one or more regulations.

463. As discussed above in **Section XII.D.1.ii**, persons of ordinary skill in the art would have been motivated to provide *Racanelli*’s computing system with

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Dintenfass's techniques for identifying changes in law, determining whether those changes in law require updating a will, and notifying a user to update a will based on a change in law. I adopt that analysis here as well. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* therefore renders obvious receiving, by the computing system, data associated with one or more modifications of the one or more regulations.

iv. 15[c]: modifying, by the computing system, the rule data based on the data associated with one or more modifications of the one or more regulations, and

464. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious modifying, by the computing system, the rule data based on the data associated with one or more modifications of the one or more regulations.

465. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

466. *Bateman* discloses rule data comprising one or more rules, as discussed above for Claim 1[c] in **Section XII.B.2.iv**. I adopt that analysis here as well.

467. As discussed above for Claim 15[a] in **Section XII.D.2.ii**, *Bateman* in view of *Dintenfass* and *Kwak* renders obvious one or more regulations. I adopt that analysis here as well.

468. As discussed above for Claim 15[b] in **Section XII.D.2.iii**, *Dintenfass* discloses receiving data associated with one or more modifications of the one or more regulations. I adopt that analysis here as well.

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469. *Dintenfass* further discloses or at least renders obvious modifying rule data based on the data associated with one or more modifications of the one or more regulations. *Dintenfass* describes that its system retrieves current state law to identify discrepancies between a will's asset allocations and the current state law: "In one aspect, the system may be configured to retrieve current state laws and accurately identify the discrepancy. In some embodiments, in response to identifying the discrepancy, the system may provide recommendations to help the user rectify the discrepancy." (Ex. 1009 [*Dintenfass*] at [0059].) Persons of ordinary skill in the art would have recognized that if the law had changed since the previous generation of the will, retrieving current state law would have retrieved the changed law—in other words, data associated with modifications of the one or more regulations. Persons of ordinary skill in the art would have been motivated to modify the rule data to reflect the current state law—*i.e.*, to conform the rule data to the retrieved current state law—so that the rule data used to assess the validity of the will in the combination of *Bateman*, *Dintenfass*, and *Kwak* was up-to-date.

470. Finally, as discussed above in **Section XII.D.1.ii**, persons of ordinary skill in the art would have been motivated to provide *Racanelli*'s computing system with *Dintenfass*'s techniques for identifying changes in law, determining whether those changes in law require updating a will, and notifying a user to update a will based on a change in law. I adopt that analysis here as well. *Racanelli* in view of

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Bateman, *Dintenfass*, and *Kwak* therefore renders obvious modifying, by the computing system, the rule data based on the data associated with one or more modifications of the one or more regulations.

- v. **15[d]: generating, by the computing system, one or more rule modification notifications associated with the one or more modifications of the one or more regulations,**

471. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious generating, by the computing system, one or more rule modification notifications associated with the one or more modifications of the one or more regulations.

472. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

473. As discussed above for Claim 15[a] in **Section XII.D.2.ii**, *Bateman* in view of *Dintenfass* and *Kwak* renders obvious one or more regulations. I adopt that analysis here as well.

474. As discussed above for Claim 15[b] in **Section XII.D.2.iii**, *Dintenfass* discloses receiving data associated with one or more modifications of the one or more regulations. I adopt that analysis here as well.

475. *Dintenfass* discloses generating and transmitting a rule modification associated with a change in law, *i.e.*, a modification of the one or more regulations: “In some embodiments, the system may be configured to transmit a notification to the user indicating that the user may have to update the estate portal application

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based on new information,” such as a “change in state or regulatory laws since the generation of the previous will.” (Ex. 1009 [*Dintenfass*] at [0064].)

476. Finally, as discussed above in **Section XII.D.1.ii**, persons of ordinary skill in the art would have been motivated to provide *Racanelli*’s computing system with *Dintenfass*’s techniques for identifying changes in law, determining whether those changes in law require updating a will, and notifying a user to update a will based on a change in law. I adopt that analysis here as well. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* therefore renders obvious generating, by the computing system, one or more rule modification notifications associated with the one or more modifications of the one or more regulations.

vi. 15[e]: wherein the one or more indications associated with the resource allocation instructions comprise the one or more rule modification notifications.

477. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious wherein the one or more indications associated with the resource allocation instructions comprise the one or more rule modification notifications.

478. As discussed above for Claim 1[d] in **Section XII.B.2.v**, *Racanelli* in view of *Bateman* renders obvious the claimed one or more indications associated with the resource allocation instructions. I adopt that analysis here as well.

479. As discussed above for Claim 15[d] in **Section XII.D.2.v**, *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious one or more rule

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modification notifications. I adopt that analysis here as well. Persons of ordinary skill in the art would have been motivated to include those rule modification notifications with the flowcharts generated according to the teachings of *Racanelli* and *Bateman* so that the user would know that the current asset allocation depicted in those flowcharts needed to be updated. In turn, that would have ensured that the user could correct the will from which those flowcharts were generated so that the will complied with the current, up-to-date law.

3. Claim 16

i. **16[p]: The computer-implemented method of claim 15, further comprising:**

480. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious the computer-implemented method of Claim 15, as discussed above in **Section XII.D.2**. I adopt that analysis here as well.

ii. **16[a]: sending, by the computing system, the one or more rule modification notifications to one or more remote computing devices associated with an entity authorized to receive the one or more rule modification notifications.**

481. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious sending, by the computing system, the one or more rule modification notifications to one or more remote computing devices associated with an entity authorized to receive the one or more rule modification notifications.

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482. As discussed above for Claim 1[a] in **Section XII.B.2.ii**, *Racanelli* discloses a computing system. I adopt that analysis here as well.

483. As discussed above for Claim 15[d] in **Section XII.D.2.v**, *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious one or more rule modification notifications. I adopt that analysis here as well.

484. *Dintenfass* discloses a system that transmits a rule modification notification to a user based on a change in state or regulatory laws:

“In some embodiments, the system may be configured to transmit a notification to the user indicating that the user may have to update the estate portal application based on new information. For example, the new information may include a death of a beneficiary, change in state or regulatory laws since the generation of the previous will, change in the residency of the user, or the like.”

(Ex. 1009 [*Dintenfass*] at [0064].)

485. *Dintenfass* further discloses that a user receives information at a user input system such as a personal computer or mobile phone, which are computing devices:

“For example, the user may use the user input system 140 to transmit and/or receive information or commands to and from the system 130. In some embodiments, for example, the user input system 140 may include a personal computer system (e.g. a non-mobile or non-portable

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computing system, or the like), a mobile computing device, a personal digital assistant, a mobile phone, a tablet computing device, a network device, and/or the like.”

(Ex. 1009 [*Dintenfass*] at [0031].)

486. As a notification is information, and as *Dintenfass* describes the user input system 140 receiving information from system 130, persons of ordinary skill in the art would have recognized that *Dintenfass* describes the system 130 transmitting the rule modification notification to the user input system 140.

487. *Dintenfass* further discloses that the user input system 140 can be connected to the system 130 that generates and transmits the notification via a wide area network or the Internet:

“As shown in FIG. 1, the system 130, and the user input system 140 are each operatively and selectively connected to the network 110, which may include one or more separate networks. In addition, the network 110 may include a telecommunication network, local area network (LAN), a wide area network (WAN), and/or a global area network (GAN), such as the Internet.”

(Ex. 1009 [*Dintenfass*] at [0030].)

488. A user input system 140 connected to the system 130 over a wide-area network or the Internet is a remote computing device in that it is a computing device that is not on the same local network as the system 130.

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489. *Dintenfass* further discloses that the user input system 140 is associated with a user (entity) authorized to receive rule modification notifications. *Dintenfass* explains that the user input system 140 that receives the rule modification notification is associated with a user: “Also shown in FIG. 1 is a user of the user input system 140.” (Ex. 1009 [*Dintenfass*] at [0029].) That *Dintenfass* describes transmitting a rule modification notification to a remote computing device associated with a user implies that the user of that remote computing device is authorized to receive the rule modification notification.

490. To the extent that disclosure is not enough, *Dintenfass* renders obvious that the user input system 140 is associated with a user (entity) authorized to receive rule modification notifications. As discussed, *Dintenfass* describes that the user input system 140 is associated with a user. (Ex. 1009 [*Dintenfass*] at [0029].) *Dintenfass* further describes requiring a user to present authentication credentials to demonstrate the user’s authorization to generate the will:

“In some embodiments, the system may be configured to request one or more authentication credentials from the user to enable the user generate a draft of the will. In some embodiments, the authentication credentials may include, but are not limited to, at least one of a username, contact information, a password, a PIN number, biometric information (e.g., physiological features such as fingerprints, finger vein and palm vein patterns, as well as

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iris and facial recognition to verify individual identities), a unique identification number associated with the user, social network information, an account number, or a card number. In some embodiments, the user information may be proprietary to the financial institution, such as an account number, a reference number to an account, a client number, or the like. In other embodiments, the user information may be public information, such as a phone number, mailing address, email address, or the like. In this way, system may be configured to confirm the identity of the user and whether the user is of sound mind and health when generating the will draft.”

(Ex. 1009 [*Dintenfass*] at [0064].)

491. As the purpose of *Dintenfass*’s rule modification notifications is to prompt a user to update the user’s will, it would have been obvious to also require the user to present authentication credentials in order to receive the rule modification notifications from the system 130. That would have ensured that only a user authorized to generate an updated will would have known about the need to update the will.

492. Finally, as discussed above in **Section XII.D.1.ii**, persons of ordinary skill in the art would have been motivated to add the law-change detection and notification features described in *Dintenfass* to *Racanelli*’s computer system. I adopt that analysis here as well. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak*

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therefore renders obvious sending, by the computing system, the one or more rule modification notifications to one or more remote computing devices associated with an entity authorized to receive the one or more rule modification notifications.

4. Claim 18

i. 18[p]: The computing system of claim 17,

493. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the computing system of Claim 17, as discussed above in **XII.B.11**. I adopt that analysis here as well.

ii. 18[a]: wherein the one or more rules are based on one or more regulations associated with the resources, and wherein the operations further comprise:

494. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* render obvious wherein the one or more rules are based on one or more regulations associated with the resources, and wherein the operations further comprise the following features of Claim 18.

495. As discussed above for Claim 15[a] in **Section XII.D.2.ii**, *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious wherein the one or more rules are based on one or more regulations associated with the resources. I adopt that analysis here as well.

496. As discussed above for Claim 17[b] in **Section XII.B.11.iii**, *Racanelli* in view of *Bateman* and *Dintenfass* render obvious one or more non-transitory

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computer-readable media storing instructions that, when executed by the one or more processors, cause the computing system to perform the operations listed in Claim 17[c]-[g]. I adopt that analysis here as well.

497. As discussed above in **Section XII.D.1.ii**, persons of ordinary skill in the art would have been motivated to combine the teachings of *Racanelli*, *Bateman*, *Dintenfass*, and *Kwak* to provide a computing system that can assess the validity of a will. I adopt that analysis here as well. Persons of ordinary skill in the art would have understood that adding that functionality to *Racanelli*'s computing system would have involved storing instructions for a processor to implement *Bateman*'s, *Dintenfass*'s, and *Kwak*'s techniques in the memory of *Racanelli*'s computing system. Thus, *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious one or more non-transitory computer-readable media storing instructions that, when executed by the one or more processors, cause the computing system to perform the operations described in or rendered obvious by *Racanelli*, *Bateman*, *Dintenfass*, and *Kwak*, including the operations listed in Claim 18[b]-18[e].

iii. 18[b]: receiving data associated with one or more modifications of the one or more regulations;

498. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious receiving, by the computing system, data associated with one or more modifications of the one or more regulations, as I discuss above for Claim 15[b] in **Section XII.D.2.iii**. Although Claim 18[b] omits “by the computing system,” the features of

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Claim 15[b] and Claim 18[b] are otherwise identical, so I adopt my analysis for Claim 15[b] here as well.

iv. 18[c]: modifying the rule data based on the data associated with one or more modifications of the one or more regulations, and

499. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious modifying, by the computing system, the rule data based on the data associated with one or more modifications of the one or more regulations, as I discuss above for Claim 15[c] in **Section XII.D.2.iv**. Although Claim 18[c] omits “by the computing system,” the features of Claim 15[c] and Claim 18[c] are otherwise identical, so I adopt my analysis for Claim 15[c] here as well.

v. 18[d]: generating one or more rule modification notifications associated with the one or more modifications of the one or more regulations,

500. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious generating, by the computing system, one or more rule modification notifications associated with the one or more modifications of the one or more regulations, as I discuss above for Claim 15[d] in **Section XII.D.2.v**. Although Claim 18[d] omits “by the computing system,” the features of Claim 15[d] and Claim 18[d] are otherwise identical, so I adopt my analysis for Claim 15[d] here as well.

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- vi. **18[e]: wherein the one or more indications associated with the resource allocation instructions comprise the one or more rule modification notifications.**

501. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious wherein the one or more indications associated with the resource allocation instructions comprise the one or more rule modification notifications, as I discuss above for Claim 15[e] in **Section XII.D.2.vi**. Although Claim 18[e] omits “by the computing system,” the features of Claim 15[e] and Claim 18[e] are otherwise identical, so I adopt my analysis for Claim 15[e] here as well.

5. Claim 20

- i. **20[p]: The one or more non-transitory computer-readable media of claim 19,**

502. *Racanelli* in view of *Bateman* and *Dintenfass* renders obvious the one or more non-transitory computer-readable media of Claim 19, as discussed above in **XII.B.12**. I adopt that analysis here as well.

- ii. **20[a]: wherein the one or more rules are based on one or more regulations associated with the resources, and wherein the operations further comprise:**

503. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious wherein the one or more rules are based on one or more regulations associated with the resources, and wherein the operations further comprise, as I discuss above for Claim 18[a] in **Section XII.D.4.ii**. The features of Claim 18[a] and Claim 20[a] are identical, so I adopt my analysis for Claim 18[a] here as well.

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iii. 20[b]: receiving data associated with one or more modifications of the one or more regulations;

504. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious receiving, by the computing system, data associated with one or more modifications of the one or more regulations, as I discuss above for Claim 15[b] in **Section XII.D.2.iii**. Although Claim 20[b] omits “by the computing system,” the features of Claim 15[b] and Claim 20[b] are otherwise identical, so I adopt my analysis for Claim 15[b] here as well.

iv. 20[c]: modifying the rule data based on the data associated with one or more modifications of the one or more regulations, and

505. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious modifying, by the computing system, the rule data based on the data associated with one or more modifications of the one or more regulations, as I discuss above for Claim 15[c] in **Section XII.D.2.iv**. Although Claim 20[c] omits “by the computing system,” the features of Claim 15[c] and Claim 20[c] are otherwise identical, so I adopt my analysis for Claim 15[c] here as well.

v. 20[d]: generating one or more rule modification notifications associated with the one or more modifications of the one or more regulations,

506. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious generating, by the computing system, one or more rule modification notifications associated with the one or more modifications of the one or more regulations, as I

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discuss above for Claim 15[d] in **Section XII.D.2.v**. Although Claim 20[d] omits “by the computing system,” the features of Claim 15[d] and Claim 20[d] are otherwise identical, so I adopt my analysis for Claim 15[d] here as well.

vi. 20[e]: wherein the one or more indications associated with the resource allocation instructions comprise the one or more rule modification notifications.

507. *Racanelli* in view of *Bateman*, *Dintenfass*, and *Kwak* renders obvious wherein the one or more indications associated with the resource allocation instructions comprise the one or more rule modification notifications, as I discuss above for Claim 15[e] in **Section XII.D.2.vi**. Although Claim 20[e] omits “by the computing system,” the features of Claim 15[e] and Claim 20[e] are otherwise identical, so I adopt my analysis for Claim 15[e] here as well.

E. Claims 4 and 5 include a logical impossibility.

508. Claim 4 recites the term “one or more relationships between the one or more entities.” Claim 5 depends from Claim 4, so Claim 5 includes the term “one or more relationships between the one or more entities.”

509. The underlined “or” in “one or more relationships between the one or more entities” creates two alternatives. The first alternative is one or more relationships “between” one entity. The second alternative is one or more relationships between more than one entity, *i.e.*, between multiple entities.

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510. The first alternative, one or more relationships “between” one entity, is logically impossible. That is because the word “between” implies at least two related items. For example, in the American Heritage Dictionary, the examples given for the definition of the word “between” involve at least two items:

- “between the trees”
- “between 11 o’clock and 12 o’clock”
- “It costs between 15 and 20 dollars.”
- “a railroad between the two cities”
- “an agreement between workers and management”
- “a certain resemblance between the two stories”
- “Between you and me, he is not qualified.”
- “Between them they succeeded.”
- “They had only a few dollars between them.”
- “choose between riding and walking”

(Ex. 1024 [American Heritage Dictionary] at 1-2.)

511. Likewise, the Cambridge Dictionary’s definitions of “between” each involve at least two items:

- “in or into the space that separates two places, people, or objects”
- “If something is between two amounts, it is greater than the first amount but smaller than the second”
- “in the period of time that separates two different times or events”

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- “among two or more people or things”
- “A discussion, argument, or game between two or more people or groups of people involves both people or groups”
- “If you choose between two things, you choose one thing or the other”
- “connecting two or more places, things, or people”
- “from one place to another”
- “separating two places or things”
- “shared by or involving two or more people or things”

(Ex. 1025 [Cambridge Dictionary] at 1-7.)

512. Persons of ordinary skill in the art would have understood (and would still understand today) that the word “between” involves at least two items. Because the word “between” involves at least two items, it is logically impossible to have a relationship “between” only one entity. Persons of ordinary skill in the art therefore would have considered the first alternative—one or more relationships “between” one entity—to be logically impossible.

513. In discussing why Claims 4 and 5 would have been obvious over *Racanelli* in view of *Bateman* and *Dintenfass*, I have addressed the second alternative: one or more relationships between multiple entities.

XIII. Secondary Considerations / Reservation of Rights

514. I am not currently aware of any evidence of any secondary considerations that would suggest the non-obviousness of the challenged claims over

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the obviousness grounds that I have discussed in this declaration. If such evidence is presented to me, I will consider it, and I reserve the right to address it in a subsequent declaration.

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XIV. Appendix A: The Challenged Claims of the '917 Patent

#	Claim Language
1[p]	A computer-implemented method comprising:
1[a]	generating, by a computing system comprising one or more processors, based on inputting one or more resource documents into one or more machine-learning models, one or more prompts comprising requests for information associated with resource allocation instructions for distribution of resources, wherein the one or more machine-learning models are configured to generate the one or more prompts based on recognition of textual features of the one or more resource documents associated with the resources, wherein the one or more resource documents comprise one or more resource document fields, and wherein the resource allocation instructions are associated with distribution of one or more assets of the resources to one or more entities comprising one or more resource recipients;
1[b]	receiving, by the computing system, one or more responses to the one or more prompts;
1[c]	generating, by the computing system, based on inputting the one or more responses and rule data comprising one or more rules associated with the resources into the one or more machine-learning models, resource data comprising one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields, wherein the one or more machine-learning models are trained based on training data comprising training resource data and training rule data, and wherein the one or more resource data fields are based on the one or more resource document fields, and wherein the one or more resource data field values are based on the one or more responses;
1[d]	generating, by the computing system, based on the resource data, one or more indications associated with the resource allocation instructions, wherein the one or more indications comprise one or more visualizations of the distribution of the one or more assets to the one or more resource recipients; and
1[e]	updating, by the computing system, the one or more visualizations in real-time based on changes in one or more values of the one or more assets.
2[p]	The computer-implemented method of claim 1, further comprising:

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#	Claim Language
2[a]	receiving, by the computing system, an asset valuation request associated with a projected asset valuation of the one or more assets; and
2[b]	determining, by the computing system, based on the resource data, the projected asset valuation of the one or more assets, wherein the one or more indications associated with the resource allocation instructions comprise the projected asset valuation of the one or more assets.
3[p]	The computer-implemented method of claim 2,
3[a]	wherein the one or more machine-learning models comprise one or more machine-learning asset projection models, and
3[b]	wherein the projected asset valuation is based on inputting the resource data and financial data into the one or more machine-learning asset projection models that are configured to generate the projected asset valuation,
3[c]	wherein the financial data comprises one or more predicted asset appreciation rates or one or more asset depreciation rates.
4[p]	The computer-implemented method of claim 1, further comprising:
4[a]	receiving, by the computing system, an asset distribution request associated with a projected asset distribution of the one or more assets to the one or more entities;
4[b]	determining, by the computing system, based on the resource data, one or more relationships between the one or more entities; and
4[c]	determining, by the computing system, based on the resource data and the one or more relationships between the one or more entities, a plurality of projected asset distributions of the one or more assets to the one or more entities,
4[d]	wherein the one or more indications associated with the resource allocation instructions comprise the plurality of projected asset distributions of the one or more assets to the one or more entities.
5[p]	The computer-implemented method of claim 4,
5[a]	wherein the one or more machine-learning models comprise one or more machine-learning distribution projection models, and

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#	Claim Language
5[b]	wherein the projected asset distribution is based on inputting the resource data and relationship data associated with the one or more relationships into the one or more machine-learning distribution projection models that are configured to generate the projected asset distribution.
6[p]	The computer-implemented method of claim 1, further comprising:
6[a]	receiving, by the computing system, one or more conditions associated with the one or more entities or the one or more assets; and
6[b]	determining, by the computing system, one or more scenarios associated with the one or more conditions, wherein the one or more scenarios comprise one or more projected valuations of the one or more assets or one or more predicted distributions of the one or more assets to the one or more resource recipients,
6[c]	wherein the one or more indications associated with the resource allocation instructions comprise the one or more scenarios associated with the one or more scenarios.
7[p]	The computer-implemented method of claim 6,
7[a]	wherein the one or more conditions comprise a possible life expectancy of the one or more entities or a possible valuation of the one or more assets.
8[p]	The computer-implemented method of claim 6,
8[a]	wherein the one or more machine-learning models comprise one or more machine-learning scenario models, and
8[b]	wherein the determining the one or more scenarios is based on inputting the resource data and the one or more conditions into the one or more machine-learning scenario models that are configured to generate the one or more scenarios.
9[p]	The computer-implemented method of claim 1, further comprising:
9[a]	receiving, by the computing system, event data comprising information associated with a plurality of events associated with the resources;
9[b]	determining, by the computing system, based on the resource data, whether one or more events of the plurality of events satisfy one or more event criteria; and

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#	Claim Language
9[c]	generating, by the computing system, one or more event notifications associated with the one or more events that satisfy the one or more event criteria,
9[d]	wherein the one or more indications associated with the resource allocation instructions comprise the one or more event notifications.
10[p]	The computer-implemented method of claim 9, further comprising:
10[a]	sending, by the computing system, the one or more event notifications to one or more remote computing devices associated with an entity that is authorized to receive the one or more event notifications.
11[p]	The computer-implemented method of claim 9,
11[a]	wherein the plurality of events comprise marriage, divorce, receipt of a new asset, birth of a child, or death of at least one of the one or more entities.
12[p]	The computer-implemented method of claim 1,
12[a]	wherein the one or more resource documents comprise one or more network policies, one or more user guides, one or more access policies, one or more authorization policies, one or more authentication policies, one or more wills, one or more trusts, a power of attorney, one or more titles, one or more deeds, one or more account resource recipient designations, one or more guardianship designations, one or more insurance policies, or one or more healthcare directives.
13[p]	The computer-implemented method of claim 1,
13[a]	wherein the generating, by the computing system, based on one or more responses and rule data comprising one or more rules associated with the resources, resource data comprising one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields, wherein the one or more resource data fields are based on the one or more resource document fields, and wherein the one or more resource data field values are based on the one or more responses comprises:
13[b]	determining, by the computing system, one or more locations associated with the one or more assets, wherein the one or more locations comprise one or more administrative divisions; and

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#	Claim Language
13[c]	determining, by the computing system, the one or more rules associated with the one or more locations.
14[p]	The computer-implemented method of claim 1,
14[a]	wherein the one or more entities further comprise one or more trustees of the resources or one or more creditors, and
14[b]	wherein the one or more assets comprise real property, tangible personal property, one or more securities, or cash.
15[p]	The computer-implemented method of claim 1,
15[a]	wherein the one or more rules are based on one or more regulations associated with the resources, and further comprising:
15[b]	receiving, by the computing system, data associated with one or more modifications of the one or more regulations;
15[c]	modifying, by the computing system, the rule data based on the data associated with one or more modifications of the one or more regulations, and
15[d]	generating, by the computing system, one or more rule modification notifications associated with the one or more modifications of the one or more regulations,
15[e]	wherein the one or more indications associated with the resource allocation instructions comprise the one or more rule modification notifications.
16[p]	The computer-implemented method of claim 15, further comprising:
16[a]	sending, by the computing system, the one or more rule modification notifications to one or more remote computing devices associated with an entity authorized to receive the one or more rule modification notifications.
17[p]	A computing system, comprising:
17[a]	one or more processors;
17[b]	one or more non-transitory computer-readable media storing instructions that, when executed by the one or more processors, cause the computing system to perform operations, the operations comprising:

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#	Claim Language
17[c]	generating, based on inputting one or more resource documents into one or more machine-learning models, one or more prompts comprising requests for information associated with resource allocation instructions associated with resources, wherein the one or more machine-learning models are configured to generate the one or more prompts based on recognition of textual features of the one or more resource documents associated with the resources, wherein the one or more resource documents comprise one or more resource document fields, and wherein the resource allocation instructions are associated with distribution of one or more assets of the resources to one or more entities comprising one or more resource recipients;
17[d]	receiving one or more responses to the one or more prompts;
17[e]	generating, based on inputting the one or more responses and rule data comprising one or more rules associated with the resources into the one or more machine-learning models, resource data comprising one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields, wherein the one or more machine-learning models are trained based on training data comprising training resource data and training rule data, and wherein the one or more resource data fields are based on the one or more resource document fields, and wherein the one or more resource data field values are based on the one or more responses;
17[f]	generating, based on the resource data, one or more indications associated with the resource allocation instructions, wherein the one or more indications comprise one or more visualizations of the distribution of the one or more assets to the one or more resource recipients; and
17[g]	updating the one or more visualizations in real-time based on changes in one or more values of the one or more assets.
18[p]	The computing system of claim 17,
18[a]	wherein the one or more rules are based on one or more regulations associated with the resources, and wherein the operations further comprise:
18[b]	receiving data associated with one or more modifications of the one or more regulations;
18[c]	modifying the rule data based on the data associated with one or more modifications of the one or more regulations; and

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#	Claim Language
18[d]	generating one or more rule modification notifications associated with the one or more modifications of the one or more regulations,
18[e]	wherein the one or more indications associated with the resource allocation instructions comprise the one or more rule modification notifications.
19[p]	One or more non-transitory computer-readable media that collectively store instructions that, when executed by one or more computing devices, cause the one or more computing devices to perform operations, the operations comprising:
19[a]	generating, based on inputting one or more resource documents into one or more machine-learning models, one or more prompts comprising requests for information associated with resource allocation instructions associated with resources, wherein the one or more machine-learning models are configured to generate the one or more prompts based on recognition of textual features of the one or more resource documents associated with the resources, wherein the one or more resource documents comprise one or more resource document fields, and wherein the resource allocation instructions are associated with distribution of one or more assets of the resources to one or more entities comprising one or more resource recipients;
19[b]	receiving one or more responses to the one or more prompts;
19[c]	generating, based on inputting the one or more responses and rule data comprising one or more rules associated with the resources into the one or more machine-learning models, resource data comprising one or more resource data fields and one or more resource data field values that correspond to the one or more resource data fields, wherein the one or more machine-learning models are trained based on training data comprising training resource data and training rule data, and wherein the one or more resource data fields are based on the one or more resource document fields, and wherein the one or more resource data field values are based on the one or more responses;
19[d]	generating, based on the resource data, one or more indications associated with the resource allocation instructions, wherein the one or more indications comprise one or more visualizations of the distribution of the one or more assets to the one or more resource recipients; and

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#	Claim Language
19[e]	updating the one or more visualizations in real-time based on changes in one or more values of the one or more assets.
20[p]	The one or more non-transitory computer-readable media of claim 19,
20[a]	wherein the one or more rules are based on one or more regulations associated with the resources, and wherein the operations further comprise:
20[b]	receiving data associated with one or more modifications of the one or more regulations;
20[c]	modifying the rule data based on the data associated with one or more modifications of the one or more regulations; and
20[d]	generating one or more rule modification notifications associated with the one or more modifications of the one or more regulations,
20[e]	wherein the one or more indications associated with the resource allocation instructions comprise the one or more rule modification notifications.

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XV. Appendix B: CV

Dr. Christopher Jules White
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Research Interests

1. AI
2. Mobile, Cloud, and Cyber-physical Security
3. Deep Learning
4. Cyber-physical Systems
5. Deployment and Configuration Optimization
6. Distributed Systems and Cloud Computing

Educational Background

- December, 2008, Ph.D., Computer Science, Vanderbilt University
- May, 2006, MS, Computer Science, Vanderbilt University
- May, 2001, BA, Computer Science, Brown University

Appointments

1. 2023-present, Senior Advisor to the Chancellor on Generative AI
2. 2021-2023, Associate Dean of Strategic Learning Programs, School of Engineering, Vanderbilt University
3. 2023-present, Professor, Computer Science, Vanderbilt University
4. 2018-2023, Associate Professor, Computer Science, Vanderbilt University
5. 2013-2018, Assistant Professor, Computer Science and Computer Engineering, Vanderbilt University
6. 2014-present, President, Ziiio, Inc.
7. 2015-2017, Chief Scientist, Optio Labs
8. 2012-2015, Chief Scientist, Cloudpoint/PAR Works
9. 2014-present, Board Member, KTK-Belt Foundation
10. 2012-2014, Chief Technology Officer, Optio Labs
11. 2010-2013, Assistant Professor, Electrical and Computer Engineering, Virginia Tech
12. 2011-2012, Visiting Scientist, Software Engineering Institute, Carnegie Mellon
13. 2009-2010, Research Assistant Professor, Electrical Engineering and Computer Science, Vanderbilt University
14. 2004-2008, Research Assistant, Distributed Object Computing Group, Vanderbilt University
15. 2006-summer, Summer Intern, Siemens Corporate Technology SE6, Munich, Germany
16. 2001-2002, IBM Enterprise Application Developer
17. 2002, Art Editor, American Center for Artists, website (www.americanartists.org)

18. 2002, Design and Technology Director, Christopher Isherwood Foundation, Santa Monica, California
19. 2000, Chief Software Architect, Software Teacher Inc.
20. 1997-1999, Art Instructor, Bay Rivers Art Guild

Honors & Awards

1. 2024 Coursera Innovation Award
2. 1,000,000 learners enrolled in my Generative AI courses on Coursera and LinkedIn Learning
3. Led the Online MS in CS at Vanderbilt to the #1 Ranking by Fortune for Online MS in CS Programs
4. Best Paper Award, International Conference on Sports Sciences Research and Technology Support 2021
5. First Place, Accuracy, NeurIPS NL2CMD Competition, 2020
6. NSF CAREER Award, CAREER: At-scale Analysis of Issues in Cyber-security and Software Engineering, CNS-1552836
7. Virginia Tech Outstanding New Assistant Professor, 2014
8. Best Paper Award, International Conference on Software Product-lines, 2008
9. Best Paper Award, International Conference on Construction Applications of Virtual Reality, 2013
10. Best Paper Award, ASCE International Workshop on Computing in Civil Engineering, 2012
11. Best Presentation Award, International Conference on Future Computers and Communications
12. Best Student Paper Award, IEEE International Symposium on Parallel and Distributed Processing with Applications, 2013
13. Best Student Paper Award, International Conference on Pervasive and Embedded Computing and Communications, 2011
14. Virginia Tech Student Engineering Council Finalist for the Undergraduate Research Advisor Award, 2015
15. Virginia Center for Innovative Technology GAP 50 Entrepreneur Award Finalist, 2015
16. Taxi Project, CS 279, Finalist in the Multi-city Innovation Campaign, 2014
17. Indoor Navigation Project, CS 279, Tied for 1st in the Multi-city Innovation Campaign, 2014

Journal Papers

- J1. Cathy Shyr, Randall W. Grout, Nan Kennedy, Yasemin Akdas, Maeve Tischbein, Joshua Milford, Jason Tan, Kaysi Quarles, Terri L. Edwards, Laurie L. Novak, Jules White, Consuelo H. Wilkins, Paul A. Harris, Leveraging artificial intelligence to summarize abstracts in lay language for increasing research accessibility and transparency, Journal of the American Medical Informatics Association, ocae186, July 2024
- J2. Douglas C. Schmidt, Jesse Spencer-Smith, Quchen Fu, and Jules White, Towards a Catalog of Prompt Patterns to Enhance the Discipline of Prompt Engineering, Ada User Journal (AUJ), Volume 44, Number 2, pp. 220-227, September 2023
- J3. Yu Yao, Maria Powell, Jules White, Jian Feng, Quchen Fu, Peng Zhang, and Douglas C. Schmidt, A Multi-stage Diagnosis Strategy based on Transfer Learning for a Class of Rare Laryngeal Movement Disorders, Elsevier Computers in Biology and Medicine, Volume 166, pp. 1-12, 2023
- J4. *Michael Sandborn, *Zachary Stoeber, *Westley Weimer, *Stephanie Forrest, *Ryan Dougherty, Jules White, Kevin Leach, Reducing Malware Analysis Overhead with Coverings, Transactions on IEEE Transactions on Dependable and Secure Computing (to appear)

- J5. *Quchen Fu, Ramesh Chukka, Keith Achorn, Thomas Atta-fosu, Deepak R. Canchi, Zhongwei Teng, Jules White, Douglas C. Schmidt, Deep Learning Models on CPUs: A Methodology for Efficient Training, *Journal of Machine Learning Theory, Applications and Practice* (to appear)
- J6. *Quchen Fu, *Zhongwei Teng, *Marco Georgaklis, Jules White, Douglas C. Schmidt, NL2CMD: An Updated Workflow for Natural Language to Bash Commands Translation, *Journal of Machine Learning Theory, Applications and Practice* (to appear)
- J7. *Peng Zhang, Christopher Fannesbeck Shelagh Mulvaney, Jules White, Douglas C. Schmidt, Understanding Barriers to Diabetes Self-Management Using Momentary Assessment and Machine Learning, *Journal of Medical Internet Research*, Volume 10, Number 3, March, 2022
- J8. *Zhongwei Teng, Jules White, Jonathan Nesbitt, Douglas C. Schmidt, Authentication & Integration Approaches for mHealth Apps Supporting Patient Reported Outcomes, *Journal of Advances in Electrical and Electronic Engineering*, Volume 19, Number 1, pp. 74-89, 2021
- J9. *Michael Sandborn, *Carlos Olea, Jules White, Chris Williams, Pablo A. Tarazaga, *Logan Sturm, Mohammad Albakri, *Charles Tenney, Towards Secure Cyber-physical Information Association for Parts, *Journal of Manufacturing Systems*, Volume 59, pp. 27-41, April 2021
- J10. Peng Zhang, Chris Downs, Nguyen Thanh Uyen Le, Cory Martin, Paul Shoemaker, Clay Wittwer, **Luke Mills, **Liam Kelly, Stuart Lackey, Douglas Schmidt, Jules White, Towards Patient-Centered Stewardship of Research Data and Research Participant Recruitment with Blockchain Technology, *Frontiers in Blockchain*, Volume 11, Number 12, pp. 12-32, July, 2020
- J11. *Josh Brandman, *Logan Sturm, Jules White, Chris Williams, A Physical Hash for Preventing and Detecting Cyber-Physical Attacks in Additive Manufacturing Systems, *Journal of Manufacturing Systems*, Volume 56, pp. 202-212, July, 2020
- J12. *Yao Pan, *Fangzhou Sun, *Zhongwei Teng, Jules White, Douglas C. Schmidt, Jacob Staples, Lee Krause, Detecting Web Attacks with End-to-End Deep Learning, *Journal of Internet Services and Applications*, Volume 10, Number 16, August 2019
- J13. Maria E. Powell, Marcelino Rodriguez Cancio, David Young, *William Nock, Beshoy Abdelmessih, Amy Zeller, Irvin Perez Morales, Dana Zhang, C Gaelyn Garrett, Douglas Schmidt, Jules White, and Alexander Gelbard, Decoding Phonation with Artificial Intelligence (DEP AI): Proof of Concept, Volume 4, Number 3, pp. 328-334, June, 2019
- J14. *Peng Zhang, *Breck Stodghill, *Cory Pitt, Cavan Briody, Douglas C. Schmidt, Jules White, Alan Pitt, and Kelly Aldrich, OpTrak: Tracking Opioid Prescriptions via Distributed Ledger Technology, the *International Journal of Information Systems and Social Change (IJISSC)*, Special Issue On: Blockchain Technology: Platforms, Tools, and Use Cases, IGI Global, 2018
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- J17. *Fangzhou Sun, Abhishek Dubey, Jules White, Aniruddha Gokhale, Transit-Hub: A Smart Public Transportation Decision Support System with Multi-timescale Analytical Services, *Journal of Cluster Computing special issue on Dynamic Data Driven Applications Systems*, Volume 22, Issue 1, pp. 2239-2254, 2019
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- J24. *Jose Galindo, David Benavides, *Hamilton Turner, Jules White, Testing Variability Intensive Systems Using Automated Analysis: An application to Android, Springer Journal of Systems and Software, Volume 24, Issue 2, pp. 365-405, June, 2016
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- J26. Max Robert, Yu Sun, Thomas Goodwin, *Hamilton Turner, Jeff Reed, Jules White, Software Frameworks for SDR, Proceedings of the IEEE, Volume 103, Number 3, pp. 452-475, April, 2015
- J27. Yu Sun, Jules White, Jeff Gray, A Demonstration-based Model Transformation Approach to Automate Model Scalability, Journal of Software and Systems Modeling, Volume 14, Issue 3, pp. 1245-1271, July, 2015
- J28. *Hamilton Turner¹, Jules White, **Brandon Amos, Jaime Camelio, Chris Williams, and Robert Parker, Bad Parts: Are Our Manufacturing Systems At Risk of Silent Cyber-attacks?, IEEE Security & Privacy, Volume 3, Issue 3, pp. 40-47, May/June, 2015
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** Undergraduate student author

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- J35. *Hyojoon Bae, Mani Golparvar-Fard, Jules White, A High-precision Vision-based Mobile Augmented Reality System for Context-aware AEC/FM Applications, *International Journal of Visualization in Engineering*, Volume 1, Number 1, pp. 1-13, 2013
- J36. *Yu Sun, Jeff Gray, Romain Delamare, Benoit Baudry, Jules White, Automating the Management of Non-functional System Properties Using Demonstration-based Model Transformation, *Journal of Software Maintenance and Evolution Research and Practice*, incorporating Software Process and Practice, Volume 25, Issue 12, pp. 1335-1356, 2013
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- J40. *Brian Dougherty, *Daniel Guymon, Jules White, and Douglas C. Schmidt, Overcoming Cellular Connectivity Limitations with M2Blue Autonomic Distributed Data Caching, *CSI Communications*, August, 2011
- J41. Jules White, **Chris Thompson, *Hamilton Turner, *Brian Dougherty, Douglas C. Schmidt, WreckWatch - Automatic Traffic Accident Detection and Notification with Smartphones, *Springer Journal of Mobile Applications and Networks*, Volume 16, Number 3, pp. 285-303, June, 2011
- J42. *Brian Dougherty, Jules White, Douglas C. Schmidt, Automated Software and Hardware Evolution Analysis for Distributed Real-time and Embedded Systems, *The Central European Journal of Computer Science*, 2011
- J43. Jules White, *Hamilton Turner, Smartphone Computing in the Classroom, *IEEE Pervasive Computing*, Volume 10, Issue 2, pp. 82-86, April-June, 2011
- J44. *Brian Dougherty, Jules White, Douglas C. Schmidt, Russell Kegley, Jonathan Preston, Deployment Optimization for Embedded Flight Avionics Systems, *CrossTalk Journal*, Volume 24, Number 6, pp. 1-8, 2011
- J45. Jules White, *Brian Dougherty, **Chris Thompson, Douglas C. Schmidt, ScatterD- Spatial Deployment Optimization with Hybrid Heuristic / Evolutionary Algorithms, *ACM Transactions on Autonomous and Adaptive Systems* Special Issue on Spatial Computing, Volume 6, Number 3, pp. 1-25, September, 2011
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- J51. Jules White, Jeff Gray, Douglas C. Schmidt, Constraint-based Model Weaving, Springer Transactions on Aspect-Oriented Software Development Special Issue on Aspects and Model-Driven Engineering, 2009, Volume 5560, Number 6, pp. 153-190
- J52. Jules White, Douglas C. Schmidt, Automating Deployment Planning with an Aspect Weaver, IET Software Special Issue on Domain-specific Modeling Languages for Aspect-Oriented Programming, Volume 3, Issue 3, pp. 167-183, June 2009
- J53. Jules White, **Harrison Strowd, Douglas C. Schmidt, Creating Self-healing Service Compositions with Feature Models and Microrebooting, International Journal of Business Process Integration and Management, Special issue on Model-Driven Service-Oriented Architectures, Inderscience Publishers, pp. 35-46, Volume 4, Number 1, 2009
- J54. Jules White, Douglas C. Schmidt, Andrey Nechypurenko, Egon Wuchner, Model Intelligence- an Approach to Modeling Guidance, UPGRADE Journal, Volume 9, Number 2, pp. 22-28, April 2008

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- J55. Jules White, Douglas C. Schmidt, Egon Wuchner, Andrey Nechypurenko, Automatically Composing Reusable Software Components for Mobile Devices, Journal of the Brazilian Computer Society Special Issue on Software Reuse, SciELO Brasil, Volume 14, Number 1, pp. 25-44, March, 2008
- J56. Jules White, Douglas Schmidt, Aniruddha Gokhale, Simplifying Autonomic Enterprise Java Bean Applications via Model-driven Engineering and Simulation, Journal of Software and Systems Modeling, Springer, Volume 7, Number 1, pp. 3-23, May, 2007 (9th most cited and 11th most downloaded Software and Systems Modeling paper as of Oct. 2009)

Conference Publications

- C1. *Ashraf Elnashar, Max Moundas, Douglas C. Schmidt, Jesse Spencer-Smith, Jules White, Evaluating the Performance of LLM-Generated Code for ChatGPT-4 and AutoGen Along with Top-Rated Human Solutions, 19th International Conference on Software Technologies, Dijon, France, July 8-10, 2024 (Received the Best Student Paper Award)
- C2. *Williams Schrieber, *Carlos Olea, Max Moundas, Jules White, Douglas C. Schmidt, Extending the Persona Pattern in Prompt Engineering for Large Language Models, 31st PLoP Conference, October 13-16, 2024, Washington, USA
- C3. Max Moundas, Jules White, Douglas C. Schmidt, Prompt Patterns for Structured Data Extraction from Unstructured Text, 31st PLoP Conference, October 13-16, 2024, Washington,
- C4. *Carlos Olea, Holly Tucker, *Jessica Phelan, *Cameron Pattison, Shen Zhang, Maxwell Lieb, Doug Schmidt, Jules White, Evaluating Personified Expert Effectiveness, International

- Conference on Artificial Intelligence and Soft Computing, Jun. 22-23, 2024, Sydney, Australia
- C5. *Ashraf Elnashar, *Max Moundas, Douglas C. Schimdt, Jesse Spencer-Smith, Jules White, Prompt Engineering of ChatGPT to Improve Generated Code & Runtime Performance Compared with the Top-Voted Human Solutions, 2023 IEEE 22nd International Conference on Cognitive Informatics & Cognitive Computing, Aug. 19-21, 2023, Stanford, CA
 - C6. José A. Galindo, Antonio J Dominguez, Jules White and David Benavides, Large Language Models to Generate Meaningful Feature Model Instances, 27th ACM International Software Product Lines Conference, Aug. 28- Sept. 1, 2023, Tokyo, Japan
 - C7. Carlos Olea, Michael Sandborn, Peter Volgyesi and Jules White, String Grammars for Preliminary UAV Design Exploration, 14th International Conference on Mechanical and Aerospace Engineering, Jul. 18-21, 2023, Porto, Portugal
 - C8. Douglas C. Schmidt, Jesse Spencer-Smith, Quchen Fu and Jules White, Cataloging Prompt Patterns to Enhance the Discipline of Prompt Engineering, International Conference on Reliable Software Technologies, June 13-16, 2023, Lisbon, Portugal
 - C9. *Michael Sandborn, *Carlos Olea, *Anwar Said, Mudassir Shabbir, Peter Volgyesi, Xenofon Koutsoukos, Jules White, What a Drag! Streamlining the UAV Design Process with Design Grammars and Drag Surrogates, International Conference on Computational Science and Computational Intelligence, Dec. 14-16, 2022, Las Vegas (24% acceptance rate)
 - C10. *Ashraf Elnashar, *William Schreiber, Jules White, Douglas C. Schmidt, Question Formulation and Transformer Resilience, International Conference on Computational Science and Computational Intelligence, Dec. 14-16, 2022, Las Vegas (24% acceptance rate)
 - C11. Sam Hays, Jules White, Using Contracts to Improve Security through Responsibility Bifurcation, European Symposium on Software Engineering, Rome, Italy, Oct. 27-29, 2022
 - C12. Zhongwei Teng, Quchen Fu, Jules White, Maria Powell, Douglas C. Schmidt, ARawNet: A Lightweight Solution for Leveraging Raw Waveforms in Spoof Speech Detection, International Conference on Pattern Recognition, August 21-25, 2022, Montreal, Quebec
 - C13. *Quchen Fu, *Zhongwei Teng, Jules White, Maria E. Powell, and Douglas C. Schmidt, FastAudio: A Learnable Audio Front-End for Spoof Speech Detection, IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), May 22-27, 2022, Singapore
 - C14. *Quchen Fu, *Zhongwei Teng, Jules White, Douglas C. Schmidt, A Transformer-based Approach for Translating Natural Language to Bash Commands, 20th IEEE International Conference on Machine Learning and Applications, December 13-16, 2021, Pasadena, CA (25% Acceptance Rate)
 - C15. *Zhongwei Teng, *Quchen Fu, Jules White, Douglas C. Schmidt, "Generating Data Visualizations from Hand-drawn Sketches Using Deep Learning", 20th IEEE International Conference on Machine Learning and Applications, December 13-16, 2021, Pasadena, CA (25% Acceptance Rate)
 - C16. *Gabriela Gresenz, Jules White, and Douglas C. Schmidt, An Off-road Terrain Dataset Including Images Labeled with Measures of Terrain Roughness, IEEE International Conference on Autonomous Systems, August 11-13, 2021, Montreal, CA (25% Acceptance Rate)
 - C17. Mayank Agarwal, Tathagata Chakraborti, Quchen Fu, David Gros, Xi Victoria Lin, Jaron Maene, Kartik Tala-madupula, Zhongwei Teng, and Jules White, NeurIPS 2020 NL2CMD Competition: Translating Natural Language to Bash Commands, Neural Information Processing Systems, Competition and Demonstration Track, December 6-12, 2020
 - C18. *Josh Brandman, *Logan Sturm, Jules White, Christopher Williams, A Physical Hash for Preventing and Detecting Cyber-Physical Attacks in Additive Manufacturing Systems, 2018 Annual International Solid Freeform Fabrication Symposium, August 13-15, 2018, Austin, TX

- C19. Peng Zhang, Douglas C. Schmidt, Jules White, Shelagh Mulvaney, Towards Precision Behavioral Medicine with IoT: Iterative Design and Optimization of a Self-Management Tool for Type 1 Diabetes, IEEE International Conference on Healthcare Informatics, June 4-7, 2018, New York, NY
- C20. Marcelino Rodriguez-Cancio, Benoit Baudry, and Jules White, Images of Code: Lossy Compression for Native Instructions, International Conference on Software Engineering, May 27-June 3, 2018, Gothenburg, Sweden
- C21. *Fangzhou Sun, *Peng Zhang, Jules White, Douglas Schmidt, Jacob Staples and Lee Krause, A Feasibility Study of Autonomically Detecting In-process Cyber-Attacks, IEEE International Conference on Cybernetics, June 21-23, 2017, Exeter, UK (30% acceptance rate)
- C22. *Peng Zhang, Jules White, Douglas C. Schmidt, Tom Dennis, Applying Machine Learning Methods to Predict Hand Hygiene Compliance Characteristics, 2017 IEEE International Conference on Biomedical and Health Informatics, February 16-19, 2017, Orlando, Florida (14% acceptance rate for oral presentation)
- C23. *Yao Pan, Jules White, Yu Sun, Assessing the Threat of Web Worker Distributed Attacks, IEEE Conference on Communications and Network Security, October 17-19, 2016, Philadelphia, PA (29% acceptance rate)
- C24. *Peng Zhang, Jules White, Douglas C. Schmidt, HoliCoW: Automatically Breaking Team-based Software Projects to Motivate Student Testing, International Conference on Software Engineering, Software Engineering in Education Track, Austin, TX, May 14-22, 2016
- C25. **Sam Hurd, **Carmen Camp, Jules White, Quality Assurance in Additive Manufacturing Through Mobile Computing, The 7th EAI International Conference on Mobile Computing, Applications and Services, Nov 12-13, 2015, Berlin, Germany (37% acceptance rate)
- C26. *Yao Pan, Jules White, Yu Sun, Jeff Gray, Gray Computing: An Analysis of Computing with Background JavaScript Tasks, International Conference on Software Engineering, May 16-21, 2015, Florence, Italy (18.5% acceptance rate)
- C27. Yu Sun, Jules White, Sean Eade, A Model-Based System to Automate Cloud Resource Allocation and Optimization, Models 2014, Sept 28-Oct 3, Valencia, Spain (23% acceptance rate)
- C28. Jules White, *Yao Pan, *Zack McCormick, Addressing the Challenges of HTTP-based Mobile/Cloud Interaction, IEEE International Conference on Mobile Cloud Computing, Services, and Engineering, Oxford, UK, April 8-11, 2014 (24.3% acceptance rate)
- C29. *Hamilton Turner and Jules White. Multi-core Deployment Optimization Using Simulated Annealing and Ant Colony Optimization, IEEE International Symposium on Parallel and Distributed Processing with Applications, Melbourne, Australia, July 16-18 2013 (***) Received the Best Student Paper Award (***) 35% acceptance rate).
- C30. **Brandon Amos, *Hamilton Turner, and Jules White, Applying Machine Learning Classifiers to Dynamic Android Malware Detection at Scale, International Security, Trust and Privacy Symposium, Cagliari, Italy, July 2013 (35% acceptance rate).
- C31. *Alan Baines, *Thaddeus Czauski, Jules White, Mani Golparvar-Fard, and Brian Dougherty, CTrack: A Cyber-Physical Approach to Construction Site Work Improvement Studies, The 9th International Wireless Communications & Mobile Computing Conference, July 1-5, 2013, Cagliari, Sardinia, Italy (35% acceptance rate).
- C32. *Hamilton Turner, *Thaddeus Czauski, *Danny Guymon, Brian Dougherty, Jules White, Dynamic Tessellation of Geographical Regions to Ensure K-Anonymity, IEEE/IFIP International Conference on Embedded and Ubiquitous Computing, Paphos, Cyprus, December 5-7, 2012 (35% acceptance rate).
- C33. *Daniel Guymon, *Alan Baines, **Jordan Scherigert, Jules White, Accelerometer-based Gesture End-user Authentication for P2P Communication on Smartphones, 4th International Conference

- on Future Computer and Communication, Hong Kong, August 3-5, 2012 (28% acceptance rate).
 (***) Received the Best Presentation Award (***)).
- C34. *Yu Sun, Jeff Gray, Christoph Wienands, Michael Golm, Jules White, A Demonstration-based Approach to Support Live Transformations in a Model Editor, International Conference on Model Transformation, Zurich, Switzerland, June 27-28, 2011 (21% Acceptance Rate)
 - C35. **Chris Thompson, *Hamilton Turner, Jules White, Douglas C. Schmidt, Analyzing Mobile Application Software Power Consumption via Model-driven Engineering, 1st International Conference on Pervasive and Embedded Computing and Communication Systems, Algarve, Portugal, March 5-7, 2011 (14% Acceptance Rate), (***)Received the Best Student Paper Award(***)
 - C36. Jules White, David Benavides, *Brian Dougherty, Douglas C. Schmidt, Automated Reasoning for Multi-step Software Product-line Configuration Problems, Software Product-lines Conference (SPLC), 10pgs. August 24-28, 2009, San Francisco, CA (30% Acceptance Rate)
 - C37. *Yu Sun, Jules White, Jeff Gray, Model Transformation by Demonstration, Proceedings of MODELS 2009, ACM/IEEE 8th International Conference on Model Driven Engineering Languages and Systems, October 4-9, 2009, Denver, Colorado (16% Acceptance Rate)
 - C38. *Brian Dougherty, Jules White, *Jaiganesh Balasubramanian, **Chris Thompson, and Douglas C. Schmidt, Deployment Automation with BLITZ, 31st International Conference on Software Engineering, May 16-24, 2009 Vancouver, Canada.
 - C39. Jules White, Douglas C. Schmidt, David Benavides, Pablo Trinidad, Antonio Ruiz-Cortez, Automated Diagnosis of Product-line Configuration Errors in Feature Models, Software Product Lines Conference (SPLC), 10pgs., September, 2008, Limerick, Ireland (30% Acceptance Rate), (***)Received the Best Paper Award(***)
 - C40. Jules White, Krzysztof Czarnecki, Douglas C. Schmidt, Gunther Lenz, Christoph Wienands, Egon Wuchner, and Ludger Fiege, Automated Model-based Configuration of Enterprise Java Applications, Enterprise Computing Conference (EDOC), 12pgs., October, 2007, Annapolis, Maryland (28% Acceptance Rate)
 - C41. Jules White, Douglas C. Schmidt, Egon Wuchner, Andrey Nechypurenko, Optimizing and Automating Product-Line Variant Selection for Mobile Devices, 11th Annual Software Product Line Conference (SPLC), 10pgs., September 10-14, 2007, Kyoto, Japan (35% Acceptance Rate)
 - C42. Andrey Nechypurenko, Egon Wuchner, Jules White, and Douglas C. Schmidt, Application of Aspect-based Modeling and Weaving for Complexity Reduction in the Development of Automotive Distributed Realtime Embedded Systems, Proceedings of the Sixth International Conference on Aspect-Oriented Software Development, 10pgs., Vancouver, British Columbia, March 12-16, 2007 (18% Acceptance Rate)
 - C43. Jules White, Douglas Schmidt, and Aniruddha Gokhale, Simplifying Autonomic Enterprise Java Bean Applications via Model-driven Development- a Case Study, Proceedings of MODELS 2005, ACM/IEEE 8th International Conference on Model Driven Engineering Languages and Systems, 11pgs., Half Moon Resort, Montego Bay, Jamaica, October 5-7, 2005. (Selected as a best paper) (27% Acceptance Rate)
 - C44. Jules White, Douglas Schmidt, and Aniruddha Gokhale, The J3 Process for Building Autonomic Enterprise Java Bean Systems, Proceedings of the International Conference on Autonomic Computing (ICAC 2005), 2pgs., Seattle, WA, June 2005 (short paper) (17% Acceptance Rate).
 - C45. Douglas C. Schmidt, Jesse Spencer-Smith, Quchen Fu, and Jules White, Cataloging Prompt Patterns to Enhance the Discipline of Prompt Engineering, International Conference on Reliable Software Technologies (AEiC 2023) 13-16 June 2023, Lisbon, Portugal
 - C46. *Henry Gilbert, Jules White, Matthew Berger, Generating Synthetic Returns Conditioned Off Macro Economic Features with Variational Autoencoders, International Conference on Intelligent Systems and New Applications, March 17-19, 2023, Liverpool UK
 - C47. *Sam Hays, Jules White, Using Contracts to Improve Security through Responsibility Bifurcation, European Symposium on Software Engineering, Rome, Italy, Oct. 27-29, 2022

- C48. *Sam Hays, *Michael Sandborn, Jules White, WiP: DNSauth - When Step Up Authentication is Not Enough, Hot Topics in the Science of Security Symposium, April 4-8, 2022, Virtual
- C49. *Henry Gilbert, Jules White, Douglas C. Schmidt, International Conference on Sports Sciences Research and Technology Support, Valletta, Malta, Oct. 27-28, 2022
- C50. *Zhongwei Teng, *Quchen Fu, Jules White, Maria Powell, Douglas C. Schmidt, SA-SASV: An End-to-End Spoof-Aggregated Spoofing-Aware Speaker Verification System, Interspeech, September 18-22, 2022, Incheon, Korea
- C51. *Althea Henslee, Haley Dozier, Ashley Abraham, Andrew Strelzoff, Alexandre Ligo, Jules White, International Conference on Data Science, July 25-28, 2022, Las Vegas, NV
- C52. *Michael Sandborn, *Carlos Olea, *Sam Hays, Jules White, An Architecture for Component Authentication Using Secure Cyber-physical Information and Blockchain, International Symposium on Future Cyber Security Technologies, Dec 6-9, 2021, Gandia, Spain
- C53. *Zhongwei Teng, **Jacob Tate, **William Nock, *Carlos Olea, Jules White, Checklist Usage in Secure Software Development, 10th International Conference on Software Engineering and Applications, December 23-24, 2021, Sydney, Australia
- C54. *Michael Sandborn, **Clayton Wright, Jules White, Towards Cyber-physical Authentication of Additively Manufactured Components, Smart Cyber-Physical Systems Symposium (SCPS 2021), November 1-4, 2021, Online
- C55. *Xiaoxing Qiu, Jules White, Douglas C. Schmidt, A Study of Machine Learning Models for Personalized Heart Rate Forecasting in Mountain Biking, 9th International Conference on Sport Sciences Research and Technology Support, October 28-29, 2021, Valletta, Malta
- C56. *Carlos Olea, Gus Omer, John Carter, Jules White, Deep Learning Action Recognition for Basketball Shot Type Identification, 9th International Conference on Sport Sciences Research and Technology Support, October 28-29, 2021, Valletta, Malta (*** Received the Best Paper Award ***)
- C57. *Alex Cheng, Jules White, Using Wayfinding Data to Understand Patient Travel Within a Medical Center, American Medical Informatics Association Symposium, November 3-7, 2018, San Francisco, CA
- C58. *Zhongwei Teng, Peng Zhang, *Xiao Li, **William Nock, Marcelino Rodriguez-Cancio, Jules White, Douglas C. Schmidt, Nesbitt, Jonathan C. Denis Michael, Authentication and Usability in mHealth Apps, IEEE HealthComm, 17-20 September, 2018, Ostrava, Czech Republic (*** Received an Outstanding Paper Award ***)
- C59. *Alex Cheng, Jules White, Automated Diagnosis of Clinic Workflows, IEEE HealthComm, 17-20 September, 2018, Ostrava, Czech Republic
- C60. *Peng Zhang, Jules White, Douglas C. Schmidt, Tom Dennis, Discussions of a Preliminary Hand Hygiene Compliance Monitoring Application-as-a-Service, 10th International Conference on Health Informatics, Porto Portugal, February 21-23, 2017
- C61. *Fangzhou Sun, *Chinmaya Samal, Jules White, Abhishek Dubey, Unsupervised Mechanisms for Optimizing On-Time Performance of Fixed Schedule Transit Vehicles, Inter-national Conference on Smart Computing, May 29-31, 2017, Hong Kong, China (37% Acceptance Rate)
- C62. *Peng Zhang, Douglas C. Schmidt, Jules White, Gunther Lenz, and Mike Walker, Metrics for Accessing Blockchain-based Healthcare Decentralized Apps, IEEE Healthcomm, October, 12-15, 2017, Dalian China
- C63. *Fangzhou Sun, Yao Pan, Abhishek Dubey, Jules White, Real-time and Predictive Analytics for Smart Public Transportation Decision Support Systems, IEEE SmartComp, St. Louis, MO, May 18-20, 2016 (34% Acceptance Rate)
- C64. Yu Sun, *Hyojoon Bae, Sukanya Manna, Jules White and Mani Golparvar-Fard, Bridging Semantics with Physical Objects using Augmented Reality, IEEE International Conference on Semantic Computing, Anaheim, CA, February 7-9, 2015
- C65. Jules White, Chris Gill, Douglas C. Schmidt, Elastic Software Infrastructure to Support Computing Clouds for Cyber-Physical Systems, IEEE Symposium On

- Object/Component/Service-Oriented Real-Time Distributed Computing, Reno, Nevada, June 10-14, 2014
- C66. *Thaddeus Czauski, *Hamilton Turner, Jules White, and Sean Eade, NERD - No Effort Rapid Development - A Framework for Deploying Mobile Cloud Industrial Control Applications, IEEE International Conference on Mobile Cloud Computing, Services, and Engineering, Oxford, UK, April 8-11, 2014 (24.3% acceptance rate)
- C67. *Hamilton Turner, *L. Justin Stiltner, *Sumedha Mohan, Kevin Kochersberger, and Jules White, An Experimentation Framework for Smartphone-based UAV Tracking and Control, AIAA Infotech@Aerospace 2013 Conference- Unmanned Systems Applications, Boston, MA, August 19-22, 2013
- C68. *Thaddeus Czauski, *Paul Miranda, and Jules White, Utilizing Cyber-Physical Systems to Rapidly Access and Guard Patient Records, International Conference on Indoor Positioning and Indoor Navigation (IPIN), Montbeliard-Belfort, France, October 28-31, 2013
- C69. Bjorn Andersson, Sagar Chaki, Dionisio de Niz, Brian Dougherty, Russell Kegley, Jules White, Non-Preemptive Scheduling with History-Dependent Execution Time, Euromicro Conference on Real-time Systems, Pisa, Italy, July 10-13, 2012
- C70. *Hamilton Turner, Jules White, Cyber-security and Data Collection Approaches for Smartphone Sensor Systems, Conference on Ground/Air Multisensor Interoperability, Integration, and Networking for Persistent ISR III, Baltimore, MD, April 23-27, 2012
- C71. *Paul Miranda, *Nikita Sharakhov, Jules White, Mani Golparvar-Fard, Brian Dougherty, Hybrid 4-Dimensional Augmented Reality, International Conference on Pervasive and Embedded Computing and Communications, Rome, Italy, February 24-46, 2012
- C72. **Zach Rattner, *Hamilton Turner, *Daniel Guymon, Brian Dougherty, Jules White, An Energy Synchronization Method for Distributed File Synchronization Algorithms on Mobile Devices, International Conference on Pervasive and Embedded Computing and Communications, Rome, Italy, February 24-46, 2012
- C73. *Brian Dougherty, *Jules White, Russell Kegley, Jonathan Preston, Douglas C. Schmidt, and Aniruddha Gokhale, Optimizing DRE System Performance with the SMACK Cache Efficiency Metric, 1st International Symposium on Secure Virtual Infrastructures (DOA-SVT'11), Crete, Greece, October 17-19, 2011
- C74. *Danny Guymon, Jules White, Brian Dougherty, Mani Golparvar-Fard, Power-efficient Cyber-physical Late Arrival Detection with Smartphones, IEEE International Conference on Cyber, Physical, and Social Computing, Dalian, China, October 19-22, 2011
- C75. *Hamilton Turner and Jules White, Verification and Validation of Smartphone Sensor Networks, International ICST Conference on MOBILE Wireless MiddleWARE, Operating Systems, and Applications, London, UK, June 22-24, 2011
- C76. *Anushi Shah, Jules White, Aniruddha Gokhale, Maximizing Service Uptime of Smartphone-based Distributed Real-time and Embedded Systems, IEEE International Symposium on Object/Component/Service-oriented Real-time Distributed Computing, Newport Beach, CA, March 28-31, 2011
- C77. **Chris Thompson, Jules White, *Brian Dougherty, **Adam Albright, and Douglas C. Schmidt, Using Smartphones and Wireless Mobile Networks to Detect Car Accidents and Provide Situational Awareness to Emergency Responders, Third International ICST Conference on MOBILE Wireless MiddleWARE, Operating Systems, and Applications, Chicago, IL, June 30-July 2, 2010 (one of four papers selected for publication in a special journal issue)
- C78. *Matthias Farwick, *Berthold Agreiter, Jules White, Simon Forster, Norbert Lanzanasto and Ruth Breu, A Web-Based Collaborative Metamodeling Environment with Secure Remote Model Access, Proceedings of the 10th International Conference on Web Engineering, Vienna, Austria, July 5-9, 2010
- C79. **J. Benjamin Gotow, **Krzysztof Zienkiewicz, Jules White, and Douglas C. Schmidt, Addressing Challenges in Delivering Augmented Reality Applications to Smartphones, Third

- International ICST Conference on MOBILE Wireless MiddleWARE, Operating Systems, and Applications, Chicago, IL, June 30-July 2, 2010
- C80. *Brian Dougherty, Jules White, **Chris Thompson, and Douglas C. Schmidt, Automating Hardware and Software Evolution Analysis, 16th Annual IEEE International Conference and Workshop on the Engineering of Computer Based Systems (ECBS), San Francisco, CA, April 13-16, 2009
- C81. Jules White and Douglas C. Schmidt, Model-Driven Product-Line Architectures for Mobile Devices, Proceedings of the 17th Annual Conference of the International Federation of Automatic Control, 6pgs., Seoul, Korea, July 6-11, 2008
- C82. Jules White and Douglas C. Schmidt, Automated Configuration of Component-based Distributed Real-time and Embedded Systems from Feature Models, Proceedings of the 17th Annual Conference of the International Federation of Automatic Control, 6pgs., Seoul, Korea, July 6-11, 2008
- C83. Jules White and Douglas C. Schmidt, Reducing Enterprise Product Line Architecture Deployment Costs via Model-Driven Deployment and Configuration Testing, Poster paper at the 13th Annual IEEE International Conference and Workshop on the Engineering of Computer Based Systems (ECBS '06), 2pgs., Potsdam, Germany, March 27th-30th, 2006
- C84. Jules White, Boris Kolpackov, Balachandran Natarajan, and Douglas C. Schmidt, Reducing Code Complexity With Vocabulary-Specific XML Language Bindings, Proceedings of the 43rd ACM Southeastern Conference, 7pgs., Atlanta, GA, March 2005.
- C85. Maria Powell, Marcelino Rodriguez Cancio, David Young, **William Nock, Beshoy Abdelmessih, Amy Zeller, Irvin Perez Morales, Peng Zhang, C. Gaelyn Garrett, Douglas Schmidt, Jules White, and Alexander Gelbard, Decoding Phonation with Artificial Intelligence: Proof of Concept, The 13th International Conference on Advances in Quantitative Laryngology, Voice and Speech Research, Montreal, Canada, June 2-4, 2019
- C86. *Logan Sturm, Chris Williams, Jaime Camelio, Jules White, Robert Parker, Cyber-physical Vulnerabilities in Additive Manufacturing Systems, 25th Annual Solid Freeform Fabrication Symposium, Austin, TX, August 4-6, 2014
- C87. *Hyojoon-Bae, Mani Golparvar-Fard, Jules White, Rapid Image-based Localization using Clustered 3D Point Cloud Models with Geo-Location Data for AEC/FM Mobile Augmented Reality Applications, ASCE International Conference on Computing in Civil and Building Engineering, Orlando, FL, June 23-24, 2014
- C88. *Hyo-joon Bae, Mani Golparvar-Fard, Jules White, Image-based Localization for Facility Management Mobile Augmented Reality Applications, Construction Research Congress, Atlanta, GA, May 19-21, 2014
- C89. *Hyo-Joon Bae, Mani Golparvar-Fard, Jules White, Modeling, Analyzing, and Visualizing 4D Spatio-Temporal Construction Site Information using Vision-based Mobile Augmented Reality Systems, CONVR 2013, 13th International Conference on Construction Applications of Virtual Reality, London, UK, 30-31 Oct 2013
- C90. *Hyo-Joon Bae, Mani Golparvar-Fard, Jules White, High-precision and Infrastructure-independent Mobile Augmented Reality System for Context-Aware Construction and Facility Management Applications, ASCE International Workshop on Computing in Civil Engineering, June 23-25, 2013, Los Angeles, CA (**Received the Best Paper Award**) (although titled a workshop, this is a multi-track event that would be considered a conference in CS and is the premier conference for computing in Civil Engineering)
- C91. *Hyo-Joon Bae, Mani Golparvar-Fard, Jules White, Enhanced HD4AR (Hybrid 4-Dimensional Augmented Reality) for Ubiquitous Context-Aware AEC/FM Applications, International Conference on Construction Applications of Virtual Reality, Taipei, Taiwan, November 1-2, 2012 (** Received the Best Paper Award **)

- C92. Mani Golparvar-Fard, *Paul Miranda, *Nikita Sharakhov, Jules White, Hybrid 4-Dimensional Augmented Reality Models for Ubiquitous Context-Aware Construction Management Applications, Construction Research Congress, West Lafayette, IN, May 21-23, 2012

Book Chapters

- B1. Jules White, Sean Hays, Qiyang Fu, John Spencer-Smith, Douglas C. Schmidt. "ChatGPT Prompt Patterns for Improving Code Quality, Refactoring, Requirements Elicitation, and Software Design." *Generative AI for Effective Software Development*, 2024, 71–108.
- B2. Michael Sandborn, Carlos Olea, Anwar Said, Mudassir Shabir, Peter Volgyesi, Xenofon Koutsoukos, Jules White, Towards AI-Augmented Design Space Exploration Pipelines for UAVs, Book series: Intelligent Computing. Artificial Intelligence (Machine Learning, Convolutional Networks, and Large Language Models. Edited by Leonidas Deligiannidis, George Dimitoglou, Hamid Arabnia, and Ahmad Tafti. Publisher: De Gruyter ISBN: 978-3-11-134400-3
- B3. Peng Zhang, Douglas C. Schmidt, Jules White, and Abhishek Dubey, Consensus Mechanisms and Information Security Technologies, *Advances in Computers*, vol. 115, 28pgs., Oreilly, 2019
- B4. Peng Zhang, Douglas C. Schmidt, Jules White, and Gunther Lenz, Blockchain Technology Use Cases in Healthcare, *Blockchain Technology: Platforms, Tools, and Use Cases*, edited by Ganesh Deka, 2018
- B5. *Michael Walker, Douglas C. Schmidt, and Jules White, "An Elastic Platform for Largescale Assessment of Software Assignments for MOOCs (EPLASAM)," *User-Centered Design Strategies for Massive Open Online Courses (MOOCs)*, edited by Ricardo Mendoza-Gonzalez, IGI Global, 2016.
- B6. **Chris Thompson, Jules White, and Douglas C. Schmidt, Analyzing Mobile Software Power Consumption via Model-driven Engineering, *Progressions and Innovations in Model-Driven Software Engineering* edited by Vicente García Díaz, Juan Manuel Cueva Lovelle, Begoña Cristina Pelayo García-Bustelo and Oscar Sanjuan Martinez, IGI Global, Hershey, PA, USA 2013
- B7. *Hamilton Turner, Jules White, Jeff Reed, Adam Porter, Madhav Marathe, Anil Vullikanti, Aniruddha Gokhale. Building a Cloud-based Mobile Application Testbed. In *Software Testing in the Cloud- Perspectives on an Emerging Discipline* edited by Scott Tilley. IGI Global 2012
- B8. *Yu Sun, Jeff Gray, Gerti Kappel, Philip Langer, Manuel Wimmer, and Jules White, A WYSIWYG Approach to Support Layout Configuration in Model Evolution, *Emerging Technologies for the Evolution and Maintenance of Software Models*, edited by Jorg Rech and Christian Bunse, IGI Global, Hershey, PA, USA 2012
- B9. *Brian Dougherty, Jules White, Douglas C. Schmidt, MDA-based Configuration of Distributed Real-time and Embedded Systems, *Model-driven Analysis and Software Development- Architectures and Functions*, edited by Janis Osis and Erika Asnina, IGI Global, Hershey, PA, USA 2011
- B10. *Yu Sun, Jules White, Jeff Gray, Aniruddha Gokhale, Douglas C. Schmidt, Model-Driven Automated Error Recovery in Cloud Computing, *Model-driven Analysis and Software Development- Architectures and Functions*, edited by Janis Osis and Erika Asnina, IGI Global, Hershey, PA, USA 2011.
- B11. Jules White, *Brian Dougherty, *Model-driven Testing and Analysis of Product-line Architectures*, *Model-driven Analysis and Software Development- Architectures and Functions*, edited by Janis Osis and Erika Asnina, IGI Global, Hershey, PA, USA 2011
- B12. Jules White, *Brian Dougherty, **Harrison Strowd, and Douglas C. Schmidt, Using Filtered Cartesian Flattening and Microbooting to Build Enterprise Applications with Self-adaptive Healing, *Software Engineering for Self-Adaptive Systems*, edited by Betty H. C. Cheng, Rogerio

- de Lemos, Holger Giese, Paola Inverardi, and Jeff Magee, Springer, Berlin, Germany, pp. 241-260, 2009
- B13. Jules White, Douglas C. Schmidt, Andrey Nechypurenko, and Egon Wuchner, Reducing the Complexity of Modeling Large Software Systems, Software Applications- Concepts, Methodologies, Tools, and Applications, edited by Pierre F. Tiako, IGI Global, Hershey, PA, USA, 2009 (originally published in Designing Software-Intensive Systems Methods and Principles)
- B14. Jules White, Andrey Nechypurenko, Egon Wuchner, and Douglas Schmidt, Reducing the Complexity of Designing and Optimizing Large-scale Systems by Integrating Constraint Solvers with Graphical Modeling Tools, Designing Software-Intensive Systems- Methods and Principles, edited by Pierre F. Tiako, IGI Global, Hershey, PA, USA, 2008
- B15. *Hamilton Turner, Jules White, **Chris Thompson, **Krzysztof Zienkiewicz, **Scott Campbell, Douglas C. Schmidt, Building Mobile Sensor Networks Using Smartphones and Web Services- Ramifications and Development Challenges, Handbook of Research on Mobility and Computing- Evolving Technologies and Ubiquitous Impacts, edited by Maria Manuela Cruz-Cunha and Fernando Moreira, IGI Global, Hershey, PA, USA 2009

Workshop Publications

- W1. *Violetta Vylegzhanina, Douglas C. Schmidt, and Jules White, Gaps and Future Directions in Mobile Security Research, Third International Workshop on Mobile Development Lifecycle, Pittsburgh, PA, October 26th, 2015.
- W2. *Hamilton Turner, Jules White, Jeff Gray, Engineering Challenges of Deploying Crowd-based Data Collection Tasks to End-User Controlled Smartphones, International Workshop on Emerging Mobile Sensing Technologies, Systems, and Applications, June 12, 2011, San Francisco, CA
- W3. *Yu Sun, *Hyun Cho, Jeff Gray, Jules White, Key Challenges for Modeling Language Creation by Demonstration, FlexiTools Workshop at the International Conference on Software Engineering, May 22, 2011, Honolulu, Hawaii
- W4. *Yu Sun, *Hyun Cho, Jeff Gray, Jules White, Supporting Feature Model Configuration using a Demonstration-based Approach, International Workshop on Product Line Approaches in Software Engineering, May 22-23, Honolulu, Hawaii
- W5. *Yu Sun, Jeff Gray, Philip Langer, Manuel Wimmer, Jules White, A WYSIWYG Approach for Configuring Model Layout using Model Transformations, International Workshop on Domain-specific Modeling, Reno, Nevada, October 17-18, 2010
- W6. *Yu Sun, Jeff Gray, Jules White, MT-Scribe- A Flexible Tool to Support Model Evolution, FlexiTools Workshop at SPLASH, Reno, Nevada, October 17, 2010
- W7. *Hyun Cho, Jeff Gray, Jules White, Ontology Support for Abstraction Layer Modularization, ACoM 2010, JeJu Island, South Korea, September 14, 2010
- W8. Jules White, Douglas C. Schmidt, R&D Challenges and Emerging Solutions for Multicore Deployment/Configuration Optimization, Future of Software Engineering Research Workshop at the International Symposium on the Foundations of Software Engineering, Santa Fe, New Mexico, November 7-11, 2010
- W9. **Chris Thompson, Jules White, *Brian Dougherty, and Douglas C. Schmidt, Optimizing Mobile Application Performance with Model-Driven Engineering, IFIP Workshop on Software Technologies for Future Embedded and Ubiquitous Systems, Newport Beach, CA, November 16-18, 2009
- W10. Jules White, Douglas C. Schmidt, Filtered Cartesian Flattening: An Approximation Technique for Optimally Selecting Features while Adhering to Resource Constraints, International Workshop on

- Analyses of Software Product Lines at the 12th International Software Product Line Conference, Limerick, Ireland, September 12, 2008
- W11. *James Hill, Jules White, Sean Eade, and Douglas C. Schmidt, Towards a Solution for Synchronizing Disparate Models of Ultra-Large-Scale Systems, Proceedings of the 2nd International Workshop on Ultra-Large-Scale Software-Intensive Systems at the 30th IEEE/ACM International Conference on Software Engineering, Leipzig, Germany, May 10-11, 2008
- W12. Jules White, Douglas C. Schmidt, **Sean Mulligan, The Generic Eclipse Modeling System, Model-Driven Development Tool Implementer's Forum at the 45th International Conference on Objects, Models, Components and Patterns, Zurich Switzerland, June, 2007
- W13. Andrey Nechypurenko, Jules White, Egon Wuchner, and Douglas C. Schmidt, Applying Model Intelligence Frameworks for Deployment Problem in Real-time and Embedded Systems, Proceedings of the MARTES Workshop- Modeling and Analysis of Real-Time and Embedded Systems at the 9th International Conference on Model Driven Engineering Languages and Systems, Genoa, Italy, October 2006.
- W14. Jules White, Andrey Nechypurenko, Egon Wuchner, and Douglas C. Schmidt, Intelligence Frameworks for Assisting Modelers in Combinatorically Challenging Domains, Proceedings of the Workshop on Generative Programming and Component Engineering for QoS Provisioning in Distributed Systems, Portland, Oregon, October 23, 2006
- W15. Jules White and Douglas Schmidt, Simplifying the Development of Product-line Customization Tools via Model Driven Development, Workshop on MDD for Software Product-lines- Fact or Fiction? at the 8th International Conference on Model Driven Engineering Languages and Systems, Montego Bay, Jamaica, October 2, 2005

Preprints

1. <https://arxiv.org/abs/2408.01768>
2. <https://arxiv.org/abs/2406.06608>
3. <https://arxiv.org/abs/2403.01626>
4. <https://arxiv.org/abs/2403.01271>
5. <https://arxiv.org/abs/2302.11382>
6. <https://arxiv.org/abs/2302.07845>
7. <https://arxiv.org/abs/2206.10034>
8. <https://arxiv.org/abs/2203.06517>
9. <https://arxiv.org/abs/2109.02774>
10. <https://arxiv.org/abs/2109.02773>
11. <https://arxiv.org/abs/2103.02523>
12. <https://arxiv.org/abs/2010.01172>
13. <https://arxiv.org/abs/1807.03227>
14. <https://arxiv.org/abs/1706.03700>
15. <https://arxiv.org/abs/2408.01768>
16. <https://arxiv.org/abs/2406.06608>
17. <https://arxiv.org/abs/2403.01626>
18. <https://arxiv.org/abs/2403.01271>
19. <https://arxiv.org/abs/2401.11599>

Magazine Articles

1. Mchangama, Jacob, and Jules White. "The Future of Censorship Is AI-Generated." *Time*, February 26, 2024.

2. Jules White, Douglas C. Schmidt, Why Don't Big Companies Keep Their Computer Systems Up to Date?, The Conversation, September 27, 2017
3. Jules White, Douglas C. Schmidt, Andrey Nechypurenko, and Egon Wuchner, Introduction to the Generic Eclipse Modeling System, Eclipse Magazine, Volume 06, January, 2007
4. Egon Wuchner, Andrey Nechypurenko, Jules White, Douglas C. Schmidt, Das "Generic Eclipse Modeling System" (GEMS)- skalierbare Domanenmodellierung leicht(er) gemacht, ObjectSpektrum, June, 2007

Poster Publications

1. *Thaddeus Czauski, *Paul Miranda, and Jules White. Utilizing Cyber-physical Systems to Rapidly Access and Guard Patient Records, presented at the 8th Via Research Recognition Day, Blacksburg, VA, 2013. (Honorable mention- 4th place clinical research student poster competition)
2. *Thaddeus Czauski, *Paul Miranda, Jules White, Utilizing Cyber-physical Systems to Rapidly Access and Guard Patient Records, International Conference on Indoor Positioning and Indoor Navigation, Montpellier, France, October 28-31, 2013
3. Jules White, Douglas C. Schmidt, "Simplifying the Development of Product-Line Customization Tools via the Generic Eclipse Modeling System," OOPSLA, eclipse Technology eXchange (eTX), Oct 16-20, 2005, San Diego, California

Demos

1. *Yu Sun, Jeff Gray, Jules White, MT-Scribe- A Tool for Recording and Inferring Model Transformations, Tool Demo, OOPSLA 2010
2. *Yu Sun, Jeff Gray, and Jules White, "MT-Scribe- An End-User Approach to Automate Software Model Evolution," Tool Demonstration, International Conference on Software Engineering (ICSE), Honolulu, HI, May 2011.

Granted Patents

1. Systems and methods for restricting access to network resources via in-location access point protocol, Number: 9,363,670, Utility Patent, 2016
2. Systems And Methods To Synchronize Data To A Mobile Device Based On A Device Usage Context, Number: 9578445, Utility Patent, 2017
3. Systems And Methods For Enforcing Access Control Policies On Privileged Accesses For Mobile Devices, 9787681, Utility Patent, 2017
4. Systems And Methods For Enforcing Security In Mobile Computing, 9773107, Utility Patent, 2017
5. Systems And Methods For Enforcing Security In Mobile Computing, 9712530, Utility Patent, 2017
6. Systems And Methods To Enforce Security Policies On The Loading, Linking, And Execution Of Native Code By Mobile Applications Running Inside Of Virtual Machines, 9609020, Utility Patent, 2017
7. Anti-distracted driving systems and methods, 10674005, Utility Patent, 2020

Patent Applications

8. Real-time Robust Tampering Detection of Products Using Piezoelectric Containers, Publication Number: 20230053576, Application, Filed August 17, 2022
9. Anti-distracted driving systems and methods, Publication Number: 20190289126, Filed April 29, 2019
10. Anti-distracted driving systems and methods, Publication Number: 20200296205, Filed April 24, 2020
11. Systems And Methods For Securing The Boot Process Of A Device Using Credentials Stored On An Authentication Token, Application Number: 20140282992, Filed March 13, 2014
12. Systems And Methods To Secure Short-Range Proximity Signals, Application Number: 20140273857, Filed: March 13, 2014
13. Systems And Methods For Securing And Locating Computing Devices, Application Number: 20140283136, Filed: March 13, 2014
14. Systems And Methods For Enhancing Mobile Device Security With A Processor Trusted Zone, 13/922,673, 2014 (Utility Application)
15. Systems And Methods To Synchronize Data To A Mobile Device Based On A Device Usage Context, 61,780,408, 2014 (Provisional Patent)
16. Systems And Methods For Securing The Boot Process Of A Device Using Credentials Stored On An Authentication Token 61/779,931, 2014 (Provisional Patent)
17. Systems And Methods For Securing And Locating Computing Devices 61/785,109, 2014 (Provisional Patent)
18. Systems And Methods To Secure Short-Range Proximity Signals 61/781,252, 2013 (Provisional Patent)
19. Mobile Security Via Aspect Oriented Programming, 61/675,927, 2013 (Provisional Patent)
20. Systems And Methods For Image-Based Searching, 61/680,843, 2012 (Utility Application)

Grants and Contracts

Total Grant Support (excluding MOOC Revenue):	> \$17M
Total Grant Support as Lead PI:	> \$2M

1. AFRL, Cloud-based IoT Acceptance Test Methodologies, \$35,000, 2/1/23-8/1/23, Co-PI, PI D. Schmidt
2. NSF, CIVIC-PG Track B: Creating an AI-based Community-wide Efficient and Equitable Response System, \$50,000, 9/28/22-3/1/23, Co-PI, PI M. Ma
3. DARPA, Design.R - AI-assisted CPS Design, \$8,696,785, 9/24/2020-9/23/2024, Co-PI, P. Volgeyes, PI, A. Ledeczi, Co-PI, J. Stzipanovits, Co-PI, X. Koutsoukos, Co-PI
4. NSF, Creating an AI-based Community-wide Efficient and Equitable Response System, \$50,000, 9/1/2022-4/1/2023, Co-PI, M. Ma, PI, G. Porumbescu, Co-PI, A. Mukhopadhyay, Co-PI
5. NSF, CPS: TTP Option: Medium: Collaborative Research: Cyber-Physical System Integrity and Security with Impedance Signatures, \$487,184, 10/1/2019-9/30/2022, PI
6. NSF, CPS: TTP Option: Medium: Collaborative Research: Cyber-Physical System Integrity and Security with Impedance Signatures: REU Supplemental Funding Request, \$16,000, 3/10/2020-9/30/2022, PI
7. NSF, CAREER: At-scale Analysis of Issues in Cyber-security and Software Engineering: REU Supplemental Funding Request, \$16,000, 3/1/18-4/30/2022, PI
8. AFRL (through subcontract with Securboron), Digital Thread Modeling Environment, \$250,000, 8/20/19-8/20/21, Co-PI, D.C. Schmidt, PI
9. NOAH Basketball, "Benchmarking Computer Vision Algorithms for Basketball," \$65,000, 7/1/29-6/30/2020, PI

10. NSF, "Development and Validation of a Mobile, Web-based Coaching Tool to Improve Pre-K Classroom Practices to Enhance Learning," \$2,685,061, 7/1/18-6/30/22, Co-PI, C. Christopher, PI, D.C. Schmidt, Co-PI
11. NSF, "I-Corps – Leaf Global Fintech: Virtual Banking Beyond Borders," \$50,000, 12/1/18-5/31/19, PI
12. Solaster, "Blockchains Data Exchange via FHIR," \$30,000, 9/1/18-8/31/19, PI
13. Securborator, "Virtualize Combat System Environment (ViCE) Phase," \$15,000, 1/1/18-3/26/18, Co-PI, D.C. Schmidt, PI
14. NSF, "CPS: Synergy: Collaborative Research: Cyber-physical Approaches to Advanced Manufacturing Security: REU Supplemental Funding Request," \$16,000, 5/10/2018-5/31/2019, PI
15. NSF CPS: Synergy: Collaborative Research: Cyber-physical Approaches to Advanced Manufacturing Security: REU Supplemental Funding Request, \$16,000, PI
16. **NSF, CAREER:** At-scale Analysis of Issues in Cyber-security and Software Engineering, CNS-1552836, \$487,243, 5/15/16-4/30/22, J. White, PI
17. AFRL, Container Hopping at Random Intervals, \$35,000, 7/19/16-1/17/17, J. White, PI
18. Vanderbilt TIPS, Advancing Data-Driven mHealth Technologies for Long-term Health and Health Behavior Change, \$200,000, J.White, Co-PI, T. Rosenbloom, PI, D.C. Schmidt, Co-PI, H. Silver, Co-PI
19. DARPA (through subcontract with BBN Technologies/Raytheon), "IMMortals," \$1,235,567 12/1/15-11/23/19, J. White, Co-PI, D.C. Schmidt, PI
20. Coursera, "Android App Development," \$50,000, Co-PI, 1/1/16-5/31/16, J. White, Co-PI
21. Varian - Industrial Internet Architect, Varian Medical Systems, Inc., \$213,810, 10/1/14-7/1/17, D.C. Schmidt, PI, J. White, Co-PI, D.C. Schmidt, PI
22. NSF, CPS-EAGER- Experiments with Smart City Hubs: Integration Platform for Human Cyber-Physical Systems In Smart Cities, \$197,556, Co-PI, 6/15/15-5/31/17, J. White, Co-PI, A. Dubey, PI
23. Vanderbilt, Rapid Hypothesis Testing on Traditional and Nontraditional Data Sources for Clinical Decision Support, \$78,580, PI, 5/22/15-6/30/17, J. White, PI, D.C. Schmidt, Co-PI
24. CPS: Synergy: Collaborative Research: Bad Parts: Cyber-physical Approaches to Advanced Manufacturing Security, NSF / DHS, \$246,861.83, 3/16/15-3/15/18 PI, J. White, PI
25. Hybrid 4-Dimensional Augmented Reality-Environments for Ubiquitous Markerless Context-Awareness Architecture/Engineering/Construction Professionals, NSF, \$299,967, 8/10/12-7/31/15, J. White, PI, M. Golparvar-fard, PI@UIUC (\$111,582 transferred to Vanderbilt)
26. Progressive Model Generation for Adaptive Resilient System Software, NAVY STTR-ONR Securborator, \$49,406, 8/6/13-1/31/14, D.C. Schmidt, PI, J. White, Faculty
27. The Robust Software Modeling Tool (RSMT) - Phase II, ONR , \$749,904.00, 6/15/14-6/14/17, D. Schmidt, PI, J.White, Co-PI
28. Automatically Devising Privacy Controls for Online Social Networks Using Contextual Information, L3, \$30,000, 4/1/13 to 3/31/14, J. White, PI, C. Clancy, Co-PI
29. Machine Learning and Metaheuristic Optimization of Cloud Computing, L3, \$30,000, 4/1/13-3/31/14, J. White, PI, C. Clancy, Co-PI
30. Hawksnest, NSA, \$204,975, 1/1/13 to 7/1/13, J. Reed, PI, J. White, Co-PI, C. Dietrich, Co-PI
31. Cyber-physical Systems Security, VT, \$20,289, 1/1/13-12/31/14, J. White, PI, J. Reed, Co-PI
32. CSR- Workshop- Computing Clouds for Cyber Physical Systems (CC-4-CPS), NSF, \$73,738, 3/13/13 to 3/14/13, D.C. Schmidt, PI, J. White, Co-PI, C. Gill, Co-PI
33. Android / Arduino Attack Surface Analysis, ARO, \$64,884, 8/15/12-8/14/13, J. White, PI, J. Reed, Co-PI
34. C2ORES, AFRL, \$300,000, 8/15/12-8/14/13, D.C. Schmidt, PI, J. White, Co-PI, J. Hill Co-PI, A. Gokhale, Co-PI
35. Dynamically Managed Mobile Security, VT-ARC, 8/10/11-12/31/11, \$100,000, J. White, PI

36. Cross-platform Data-Intensive Smartphone Applications, Siemens, 10/1/11-9/30/2012, \$99,937, J. White, PI
37. Enhanced Reality for Military Applications, Institute for Critical Technologies and Applied Science, 9/1/2011-8/31/2012, \$40,000, J. Reed, PI, J. White, Co-PI
38. The Android Tactical Application Analysis and Knowledge Cloud, ARO, 6/15/2011-6/14/2012, \$250,000, J. White, PI, J. Reed, Co-PI, S. Hasan, Co-PI, A. Porter, Co-PI, A. Gokhale, Co-PI, T. Bapty, Co-PI
39. RAPID- Collaborative Research- Cloud Environmental Analysis and Relief, NSF, 8/14/10-8/14/12, \$65,201, J. White, PI
40. Predictive Cache Modeling and Analysis, AFRL, (subcontract through Lockheed Martin Aeronautics), 4/8/10-10/8/2011, \$230,000, J. White, PI, D.C. Schmidt, Co-PI
41. Automated Deployment and Configuration of Distributed Real-time and Embedded System Software Using Heuristic Search Techniques, NSF, 9/1/09-9/1/12, \$472,000, A. Gokhale, PI, J. White, Co-PI
42. Vanderbilt IDEAS, \$200,000, Y. Cui, PI, A. Gokhale, Co-PI, K. Pence, Co-PI, D. Schmidt, Co-PI, and J. White, Co-PI
43. Early Integration and Performance Testing of Heterogeneous Computing Environments, Australian DoD, 1/1/09-7/1/09, \$180,000, D.C. Schmidt, PI, J. White, Co-PI, J. Hill, Co-PI, and A. Gokhale, Co-PI
44. Visual Software- Reducing the Complexity of Student Software Development through Model-Driven Development, Teaching as Research (TAR) Award, Vanderbilt Center for Teaching, 9/1/08-12/28/08, \$3,000, Fall, 2008, J. White, PI

Research Commercialization & Faculty Entrepreneurship

1. Co-founder & Chief Scientist, Optio Labs, ~\$12.5M in venture funding, sells mobile security products for classified mobile devices
2. Co-founder & Chief Scientist, PAR Works, \$1M Seed Round from Allied Minds Inc., sold advanced mobile/cloud computer vision products for retail
3. Co-founder of Ziiio, Inc., sells indoor positioning solutions with customers, such as Ascension (131 hospitals), HCA, and Vanderbilt University Medical Center.

Entrepreneurship & Commercialization Awards

1. 2013 Consumer Electronic Show (CES) Innovation Award for HD4AR (commercialized as PAR Works)
2. 2013 Technical Achievement Finalist for HD4AR at SXSW (commercialized as PAR Works MARS)
3. 2013 Accelerator Award Finalist for HD4AR at SXSW (commercialized as PAR Works MARS)

Selected Consulting

1. VIDA Inc., Spring Framework Consulting
2. 4D Technologies, Bluetooth Positioning Consulting
3. ConnectYourCare / 40AU, Spring Framework Consulting
4. CTIA – Largest Wireless Trade Group, Authored Reports on Mobile Security and Remote Locking of Devices
5. Amazon, Inc., Expert Witness for Patent Litigation

6. Apple Inc. Expert Witness & Consultant for Patent Litigation (via Bridges Mavrakkis, Wong Cabello, Kirkland & Ellis, Hoyt, Fleming & Dowler, and Morrison & Foerester), Expert Consulting for Patent Litigation
7. JP Morgan, Expert Consultant for Patent Litigation
8. IBM, Expert Consultant for Patent Litigation
9. IBM (via Desmarais LLP), Expert Consulting for Patent Litigation
10. Optio Labs, Inc., CTO/Chief Scientist
11. PAR Works/Cloudpoint, Inc., Chief Scientist
12. Ziiio, Inc., President

Professional Service

Program/Conference Chairs

1. Social Media Chair, CPS Week, 2021
2. Program Chair, 2015 International Conference on Software Product Lines
3. Program Vice-Chair, IEEE/ACM International Conference on Cyber, Physical, and Social Computing, Dalian, China, October 19-22, 2011
4. Program co-Chair, International Symposium on Secure Virtual Infrastructures, Crete, Greece, October 17-19, 2011
5. Local arrangements chair for the 2009 Distributed Event-based Systems Conference (DEBS), Nashville, TN, July 6-9
6. Publicity chair for the MoDELS 2007 conference, Nashville, TN, Oct. 1-5, 2007

Special Journal Issue Editorships

7. Chief Editor, Proceedings of the IEEE Special Issue on Applications of Augmented Reality Environments
8. Guest Editor, IEEE SW 2013 - IEEE Software Special Issue on Next Generation Mobile Computing

Conference / Workshop Organization

9. Co-organizer, CSR Workshop: Computing Clouds for Cyber Physical Systems (CC-4-CPS)
10. Co-organizer, Smartphones in the Curriculum Workshop at the 24th IEEE Conference on Software Engineering Education and Training, Waikiki, Honolulu, Hawaii, May 22, 2011
11. Co-organizer, The Object-Oriented Trivia Show at SPLASH (formerly OOPSLA) 2010, Reno, Nevada
12. Co-organizer of the Model-Driven Development Tool Implementor's Forum Workshop, TOOLS 2007, Zurich, Switzerland, June, 2007

Grant Review Panels

I have participated in grant review panels for the NSF programs for many years.

Conference Committees / Panels

13. Program committee, NSF CPS PI Meeting, 2021

14. Panelist, Big Data + Privacy in the COVID Era, Vanderbilt Webinar, 2020
15. Program committee, SPLC, 2017
16. Program committee, SPLC, 2016
17. Program committee, Modelsward 2015
18. Program committee, PECCS 2015
19. Program committee, GPSE, 2015
20. Program committee, Artificial Intelligence and Software Engineering (AISE) track again at BICT 2014
21. Program committee, IEEE/IFIP Conference on Embedded and Ubiquitous Computing, Paphos, Cyprus, October 3-5, 2012
22. Program committee, International Conference on Software Product Lines, Salvador, Brazil, September 2-12, 2012
23. Program committee, International Conference on Pervasive and Embedded Computing and Communication Systems, Rome, Italy, February 24-26, 2011
24. Judge, ACM Student Research Competition, SPLASH 2011, Portland, OR, October 24-27, 2011
25. Program committee, The 9th IEEE/IFIP International Conference on Embedded and Ubiquitous Computing, Melbourne, Australia
26. Program committee, Model-Driven Engineering, Logic and Optimization Workshop, June 6, 2011, University of Birmingham, Birmingham, UK
27. Program committee, 49th International Conference on Objects, Models, Components and Patterns, Zurich, Switzerland, June 28-30, 2011
28. Program committee, International Conference on Pervasive and Embedded Computing and Communication Systems 2011, Algarve, Portugal
29. Program committee, IEEE/ACM International Conference on Green Computing and Communications (GreenCom) 2010, Hangzhou, China
30. Program committee, IEEE International Conference on High Performance Computing and Communications (HPCC 2010), Melbourne, Australia
31. Program committee, IEEE International Workshop on Mobile Cyber-Physical Systems 2010, Xi'an, China
32. Program committee, Artificial Intelligence and Software Engineering Track, 5th International ICST Conference on Bio-Inspired Models of Network, Information, and Computing Systems (BIONETICS 2010)
33. Student research competition committee for the Systems, Programming, Languages, Architectures, and Software for Humanity (SPLASH formerly known as OOPSLA), October, 2010, Reno, Nevada.
34. Doctoral symposium panel, OOPSLA 2009, Orlando, FL, October 27, 2009
35. Program committee, European Conference on Modeling Foundations and Applications, Paris, France, June 15-18, 2010
36. Program committee, VaMos 2010, Pohang, South Korea, January 27-29, 2010
37. Reviewer, Models 2009, Denver, CO, October 4-9, 2009
38. Program committee member of the 2009 European Conference on Model Driven Architecture - Foundations and Applications (ECMDA-FA), Enschede, The Netherlands
39. Program committee member of the Models@Runtime workshop, Models 2007, Nashville, TN
40. Panel moderator at the MoDELS 2008 conference, Toulouse, France, Sept. 28-Oct. 3, 2008
41. Panels moderator for the MoDELS 2006 conference, Genoa, Italy, Oct. 2-5, 2006

Academic Service

1. Associate Dean for Strategic Learning Programs 2021-present
2. Founding Member of LIVE

3. Director of the Online MS in Computer Science, 2019-present
4. Advisor for over 200 second majors and minors in Computer Science, 2018-2021
5. Computer Engineering Class of 2018 advisor, 2014-2018
6. Faculty seminar at Vanderbilt University Commencement 2017
7. Member of the faculty search committee for Big Data 2015-2016
8. Mentor for the Innovation Garage Program with Accenture and the Wondr'y, 2016-2020
9. Participated in the Fall 2016 Vanderbilt Board of Trust Dinner
10. Selected to offer one of the inaugural "University Courses" for Vanderbilt in 2016
11. Gave the Vanderbilt University Family Weekend Faculty Lecture for the School of Engineering on "What Happens When the Phones and Machines Outnumber Us? How Mobile Computing, the Internet of Things, and Cyber-security Will Impact Our Lives", 2015
12. Member of the Faculty Search Committee in Computer Science, 2016
13. Developed the Vanderbilt University Medical Center "Walkways" app that is used for wayfinding across the medical center, 2014-2020
14. Directed a graduate student that developed a mobile augmented reality application that was sent out to 1,000s of Vanderbilt alumni and donors to promote the new engineering building, 2017
15. Served on the Dean's committee that produced a report on Vanderbilt research and sensor systems, 2016
16. Served on the Dean's committee that produced a report on Vanderbilt research and Big Data in the curriculum, 2016
17. Member of the Vanderbilt committee reviewing mobile applications for the university, 2014-2017
18. Participated in the Engineering Open House for prospective students, 2014
19. Invited by the CTTC and spoke on two panels at the Nashville meeting of the Association of University Technology Transfer Managers, 2014
20. Gave a talk to the Engineering School's Board of Visitors on MOOCs & possible plans for a professional MS program, 2014
13. Gave a talk to the EECS Department's Industry advisory board, 2014
14. Spoke to the CTTC's Entrepreneurship Advisory Board, 2014
15. Spoke to an undergraduate dorm, through an invitation from Doug Fisher, about mobile computing, 2014
16. Established a partnership with the Emergency Department in VUMC and led the team that is helping them to develop a secure messaging system for doctors in the ER, 2013
17. Gave a research talk to Schneider Electric as part of their visit to form a strategic partnership with the university, 2013
18. Member of the ECE Department Head search committee at Virginia Tech, 2012
19. Member of the ECE faculty search committee at Virginia Tech, 2012
20. Member of the College of Engineering Faculty Entrepreneurship Taskforce at Virginia Tech, 2011-2012
21. Member of the ECE Dept IT Committee at Virginia Tech, 2010-2013
22. Presentation to the Freshman Engineering Seminar, 2011
23. CPE Representative for Graduate Student Open House, 2011
24. Demo for VT-IDEA Group, 2011
25. Marcher in College of Engineering Commencement Ceremony, 2011

Community Service

1. Past President and Board Member for the KTK Belt Foundation, which successfully established a 260,000-acre protected area in Nepal, to safeguard snow leopards, red pandas, and blue sheep, helping link 1.3 million acres of existing high altitude habitat. In addition, while I was President of the Board, KTK-BELT created 6 biodiversity 'Learning Grounds' campuses to teach

biodiversity to young people and protect many endangered species across 6 different ecoregions of Nepal. 2012-2021

2. Past Board Member for the KTK Belt Foundation
3. Mentor for LaunchTN Tech Day 2015
4. Connected Nashville Technology Standards Committee 2016
5. Developed the indoor “wayfinding” app for the Music City Center (MCC) in Nashville. As part of this effort, I was honored by the Mayor at an unveiling ceremony in the MCC that was covered by several TV stations and national press. This work also appeared on the front page of Vanderbilt.edu. 2013-2020
6. Worked closely with the Office of Innovation for the City of Nashville to connect Vanderbilt research and undergraduates to key challenges for the city. 2014-2017
7. Worked with Metro Nashville Public Schools to develop a platform for managing after school program data and coordinating with after school providers as part of my 2015 CS 279 class. 2015

Doctoral Theses Supervised

- P1. Quchen Fu (2023) — Beyond Audio Quality: Understanding and Improving Human Voice Communication with Low-Resource Deep Learning
- P2. Zhongwei Teng (2022) — Model Architectures and Algorithms for Frugal Deep Learning
- P3. Peng Zheng (2018)—Blockchain in Healthcare (Assistant Professor, Belmont University)
- P4. Fangzhou Sun (2018)—Smart Cities (Senior Research Scientist, Facebook)
- P5. Yao Pan, PhD (2017)—Gray Computing (Senior Software Engineer, LinkedIn)
- P6. Hyojoon Bae, PhD (2014)— “High Precision 4 Dimensional Augmented Reality.” (Senior Research Scientist, Apple)
- P7. Hamilton Turner, PhD (2014)— “Optimizing the Deployment and Configuration of Mobile Cloud Computing.” (CTO for multiple companies, currently CEO of own company)

Master’s Theses Supervised

- M1. Gabriela Gresenz, MS (2021) – “Automated Classification of Terrain Roughness Using Deep Learning”
- M2. Xiaoxing Qiu, MS (2021) – “Personalized & Course-specific Human Performance Prediction Using Deep Learning”
- M3. Wang Meng, MS (2015) - “iBeacon Fingerprinting with Machine Learning”
- M4. Weichen Wang, MS (2015)- “Moving Target Container Cyber-Defenses and Quality of Service”
- M5. Songtao Hei, MS (2015) - “Machine-learning Prediction of Graph Centrality for Opensource Repository Systems”
- M6. Paul Miranda, MS (2012)— “High Precision Augmented Reality Using Structure from Motion”.
- M7. Daniel Guymon, MS (2012)— “Cyber-physical Late Arrival Detection and Bluetooth P2P Security Improvements”

Current Graduate Students

- G1. Carlos Olea, Ph.D.
- G2. Michael Sandborn, Ph.D.
- G3. Henry Gilbert, Ph.D.

- G4. Althea Kelly, Ph.D.
- G5. Sam Hays, Ph.D.
- G6. Ashraf Elnashar, Ph.D.
- G7. William Schrieber, Ph.D.

Visiting International Graduate Students

- I1. Yu Yao, Ph.D., College of Information Science and Engineering, Northeastern University, P.R. China, 2019-2021
- I2. Marcelino Rodriguez, Ph.D., Inria, France, 2017-2018
- I3. Jose Galindo, Ph.D., University of Seville, 2012-2013

Doctoral Thesis Committees

- 1. Charles Hartsell, Ph.D. (current), committee member
- 2. Zihao Zhan, Ph.D. (2020), committee member
- 3. Himanshu Neema (2018), Ph.D. committee member
- 4. Asish Tapdiya (2018), Ph.D. (DBMI) committee member
- 5. Alex Cheng (2018), Ph.D. (DBMI) committee member
- 6. Kyoungcho An (2015), Vanderbilt University
- 7. Jose Galindo (2014), University of Seville
- 8. Faruk Caglar (2014), Vanderbilt University
- 9. Alexandru Turcu (2014), Virginia Tech
- 10. Peng Lu (2013), Virginia Tech
- 11. Benjamin Shelton (2013), Virginia Tech
- 12. Tripti Saxena (2012), Vanderbilt University
- 13. Brian Dougherty (2011), Vanderbilt University
- 14. Yu Sun (2011), University of Alabama
- 15. Lisa Durbeck (2012), Virginia Tech

Post-doctoral Fellows Mentored

- 1. Marcelino Rodriguez (2018), CTO Couture Technologies
- 2. Dr. Yu Sun (2014), Associate Professor Cal State Pomona
- 3. Dr. Brian Dougherty (2012), Chief Operating Officer Briovation

Courses Taught

Overall Instructor Rating Average Across 29 Courses: 4.46 out of 5.0

- 1. CS 4279/CS5279, Software Engineering Projects, Spring 2023
- 2. CS 4277/5277, Cybersecurity, Fall 2022
- 3. CS 6387, Topics in Software Engineering / Cybersecurity, Fall 2022
- 4. CS 6387, Topics in Software Engineering / Cybersecurity, Spring 2022
- 5. CS 4277/5277, Cybersecurity, Fall 2021
- 6. CS 6387, Topics in Software Engineering / Cybersecurity, Fall 2021

7. CS 5278, Principles of Software Engineering, Spring 2021 (4.67 out of 5.0 overall instructor rating), 24 grad
8. CS 4279/5279, Software Engineering Projects, Spring 2021 (4.5 out of 5.0 overall instructor rating), 26 ugrad and 2 grad
9. CS 4277 / 5277 Cybersecurity, Fall 2020, 34 students (overall instructor rating of 4.61 out of 5)
10. CS 5278 Principles of Software Engineering, Fall 2020, 21 students (overall instructor rating of 4.67)
11. CS 5278, Principles of Software Engineering, Summer 2020, 5 students, (overall instructor rating of 5.0 out of 5.0)
12. CS 4279 / 5279 Software Engineering Projects, Spring 2020, 28 students (overall instructor rating of 4.5 out of 5)
13. CS 6385 Advanced Software Engineering, Spring 2020, 7 students (overall instructor rating of 4.8 out of 5)
14. CS 4279 / 5279 Software Engineering Projects, Spring 2019, 42 students (overall instructor rating of 4.64 out of 5.0)
15. CS 6387 Topics in Software Engineering, Fall 2019, 8 students (overall instructor rating of 5 out of 5)
16. CS 4277 / 5277 Cyber-security, Fall 2019, 31 students (overall instructor rating of 4.46 out of 5).
17. CS 4279 / 5279 Software Engineering Projects, Spring 2018 (overall instructor rating of 4.83 out of 5).
18. CS 4278 / 5278 Principles of Software Engineering, Fall 2018, (overall instructor rating of 3.8 out of 5).
19. CS 4279/5279, Software Engineering Projects, Spring 2017 (overall instructor rating of 4.25 out of 5, current, 22 ugrad and 2 grad)
20. UNIV 3278/5278, Tackling Big Questions with Mobile Cloud Computing, Spring 2017 (overall instructor rating of 3.6 out of 5, current, 14 ugrad and 1 grad)
21. UNIV 3278 Tackling Big Questions with Mobile Cloud Computing, Fall 2016, 11 students (overall instructor rating of 5.0 out of 5, 11 non-CS ugrad)
22. CS 4278, Principles of Software Engineering, Fall 2016, 38 students (overall instructor rating of 2.93, 35 ugrad and 3 grad)
23. CS 4279, Software Engineering Projects, Spring 2016 (overall instructor rating of 4.66 out of 5, 15 ugrad and 2 grad)
24. CS 4278, Principles of Software Engineering, Fall 2015, 38 students (overall instructor rating of 4.36, 30 ugrad and 1 grad)
25. CS 279 Software Engineering Projects, Spring, 2015 (overall instructor rating of 4.85 out of 5)
26. CS 278 Principles of Software Engineering, Fall, 2014 (overall instructor rating of 4.1 out of 5, 31 students)
27. CS 279 Software Engineering Projects, Spring, 2014 (overall instructor rating of 4.66 out of 5, 17 students)
28. CS 278, Principles of Software Engineering, Fall, 2013 (overall instructor rating of 4.3 out of 5, 15 students)
29. ECE 4564 Network Application Design, Virginia Tech, Fall, 2012 (overall instructor rating of 5.21 out of 6, 45 students)
30. ECE 4564 Network Application Design, Virginia Tech, Fall, 2011 (overall instructor rating of 5.32 out of 6, 45 students)
31. ECE 3574 Applied Software Design, Virginia Tech, Spring, 2011 (overall instructor rating of 4.89 out of 6, 37 students)
32. ECE 6504 Foundations of Mobile Cyber-physical Applications, Virginia Tech, Spring, 2011 (overall instructor rating of 4 out of 4, 10 students)
33. ECE 4564 Network Application Design, Virginia Tech, Fall, 2010 (overall instructor rating of 3.7 out of 4, 46 students)

34. EECE 261 Voice and Data Communications, Vanderbilt University, Fall, 2009 (overall instructor rating of 4.4 out of 5)
35. EECE 262 Local Area Networks and Smartphone Networking Projects, Vanderbilt University, Spring, 2010 (overall instructor rating of 4.5 out of 5)
36. CS 279 Software Engineering Projects, Vanderbilt University, Spring, 2009 (overall instructor rating of 4.8 out of 5)
37. CS 278 Principles of Software Engineering, Vanderbilt University, Fall, 2008 (overall instructor rating of 4.66 out of 5, 5 is "Excellent")

Undergraduate Research Supervised for Credit (additional non-credit supervision not listed)

1. CS 3860/3861/3850 Undergraduate Research / Independent Study, Fall, 2020 (4 students)
2. CS 3860/3861/3850 Undergraduate Research / Independent Study, Spring, 2020 (17 students)
3. CS 3860/3861/3850 Undergraduate Research / Independent Study, Fall, 2019 (16 students)
4. CS 3860/3861/3850 Undergraduate Research / Independent Study, Spring, 2019 (6 students)
5. CS 3860/3861/3850 Undergraduate Research / Independent Study, Fall, 2018 (12 students)
6. CS 3860/3861/3850 Undergraduate Research / Independent Study, Spring, 2018 (2 students)
7. CS 3860/3861/3850 Undergraduate Research / Independent Study, Fall, 2017 (14 students)
8. CS 3860/3861/3850 Undergraduate Research / Independent Study, Spring, 2016 (6 students)
9. CS 240, Undergraduate Research, Spring, 2015, (2 students)
10. CS 240, Undergraduate Research, Spring, 2014, (3 students)
11. CS 240, Undergraduate Research, Spring, 2014, (1 student)
12. ECE 4974 & 4994, Undergraduate Research / Independent Study, Spring/Fall 2012 (6 students)
13. ECE 4974 & 4994, Undergraduate Research / Independent Study, Spring/Fall 2011 (6 students)

Massively Open Online Courses (MOOCs)

1. First Coursera Trans-institutional MOOC on Mobile Cloud Computing, https://www.coursera.org/specialization/mobilecloudcomputing/2?utm_medium=listingPage
2. Pattern Oriented Software Architectures: Programming Mobile Services for Android Handheld Systems, 90,000 students, 2014, <https://www.coursera.org/course/posa>
3. Programming Cloud Services for Android Handheld Systems, 78,000 students, 2014, <https://www.coursera.org/course/mobilecloud>
4. Engineering Maintainable Android Apps, 1,200 students, 2017, <https://www.coursera.org/learn/engineeringandroidapps>

Tutorials

1. Mobile Security, Virginia Tech WiCAT Conference, 2012, Blacksburg, VA
2. Model-driven Engineering, ACM Southeast Conference 2010, Oxford, MS
3. Product-line Modeling and Automation with Eclipse, OOPSLA 2008, Nashville, TN, USA, Oct. 20, 2008
4. Product-line Modeling and Automation with Eclipse, Models 2008, Toulouse, France, Sept. 28, 2008
5. Domain-specific Modeling Languages, OOP 2008, Munich, Germany, Jan. 25, 2008
6. Model-Driven Development, MoDELS 2006 conference, Genoa, Italy, Oct. 2-5, 2006

Courses Created or Significantly Redesigned

1. **Created UNIV 3278/5278, Tackling Big Questions with Mobile Cloud Computing** - The new UNIV course and my existing CS 4278/4279 courses, now leverage an innovative format that pairs CS and non-engineering students in interdisciplinary teams. Giving students exposure to interdisciplinary software development is critical, since this is the norm of real-world software development. The unique approach has been discussed in several articles by the university (<https://my.vanderbilt.edu/universityfundingprograms/2017/01/one-on-one-with-the-faculty-behind-tackling-big-questions-with-mobile-cloud-computing-part-1-of-3>, <https://engineering.vanderbilt.edu/news/2016/schmidt-white-peers-across-vanderbilt-teach-mobile-cloud-computing-to-diverse-majors>).
2. **Redesigned CS 278, Principles of Software Engineering** – I redesigned CS 278 to have a cloud computing and mobile focus. The new material included topics on software engineering automation for dealing with large-scale testing and deployment of cloud computing applications. I also added a new focus on code reviewing and writing loosely coupled, extensible applications.
3. **Redesigned CS 279, Software Engineering Projects** – This course had not been taught in previous years and I significantly revamped it to increase student involvement with real-world software engineering challenges. I reached out to the city of Nashville and established a deep collaboration with the Office of Innovation. Projects for the course have been sourced from the Music City Center, Metro Nashville Public Schools, and the Dept. of Public Works. Two of the teams from the 2014 course entered the Multi-City Innovation Challenge. One team tied for 1st (against entrepreneurs and not students!) and the other team was in the top 10.
4. **Redesigned ECE 4564 Network Application Design** – I redesigned the Virginia Tech Network Application Design course to focus on mobile cloud computing. A particular emphasis was placed on undergraduate research in the course. Undergraduates from the course went on to win awards, such as being a Computer Research Association Undergraduate Researcher of the Year Award and author first-author conference publications.
5. **Created the Coursera MOOC, Building Sustainable Android Apps** – This MOOC course introduces students to the software engineering principles needed to test and evolve applications over time. The course has had 15,000 visitors since its launch two weeks ago and currently has ~500 active students engaged.
6. **Created the Coursera MOOC, Programming Cloud Services for Android Handheld Systems** – This MOOC course challenged me to create the highest quality educational materials for the 78,000 students in the course. I developed a low-cost technique for building a “lightboard” and used it for teaching my MOOCs. An example of the technique, which costs ~\$150 to implement, is available at www.youtube.com/playlist?list=PLyUIngzGzkzsXHItNSx_KPyC62hsrAgrK. I used this technique to create 12 hours of innovative lecture content that would not be possible without using costly video production effects. I also developed an automatic grading system for complex Java assignments that was used to grade roughly 7,000 programming assignments. This infrastructure provided instant detailed feedback on assignments with references to videos that students should re-watch based on missed questions and security measures to help detect and defeat cheaters.
7. **Created ECE 6504 Foundations of Mobile Cyber-physical Systems** – This course at Virginia Tech focused on graduate research projects. The projects completed by the graduate students created a number of novel contributions to the field of mobile cyber-physical applications, including: 1) the first mobile method for high-precision augmented reality using structure from motion computer vision algorithms; 2) a high-performance and resource efficient cloud-based approach for predicting what individuals will be at a given location in the future; 3) a new dynamic tessellation algorithm for ensuring K-anonymity in crowd-sourced participatory sensing networks; 4) empirical validation of commodity smartphone GPS and middleware accuracy for use in dynamic software-defined radio adaptation on UAVs; 5) a power-efficient state-based approach to detecting lateness both indoors and outdoors; 6) an approach for using the physical

world as the context for secure pairing of smartphones without 3rd party signatories; and 7) an architecture for building ad-hoc 911 services in third-world nations using smartphones.

Selected Press

The following is a selected list of the press coverage that the research and teaching projects I have worked on have received-

1. IBM Research Blog, Coders worldwide help computers understand natural language, <https://www.ibm.com/blogs/research/2020/12/ai-natural-language-competition/>
2. US News, How Technology Helps Visitors and Others Navigate Hospitals, <http://health.usnews.com/wellness/articles/2017-01-18/how-technology-helps-patients-and-other-visitors-navigate-hospitals>
3. Droid Report, Augmented Reality Interview, <http://www.droidreport.com/jules-white-assistant-professor-computer-science-vanderbilt-university-interview-7640>
4. Forbes, Roundup of Free Cloud Computing Online Courses, <http://www.forbes.com/sites/louisclumbus/2014/01/30/roundup-of-free-cloud-computing-online-courses/>
5. eCampus News, 7 Free Online Cloud Computing Courses, <http://www.ecampusnews.com/technologies/cloud-computing-online-311/>
6. MIT Technology Review, The Most Controlling Smartphone Ever Made, <http://www.technologyreview.com/news/508056/the-most-controlling-smartphone-ever-made/>
7. ARS Technica, Researchers Lock Down Android to Keep Data from Walking Out of the Door, <http://arstechnica.com/business/2011/10/researchers-lock-down-android-to-keep-data-from-walking-out-the-door/>
8. Time, Researchers Fine-tune Android to Lock Apps Based on Location, <http://techland.time.com/2011/10/25/researchers-fine-tune-android-to-lock-apps-based-on-location/>
9. Wall Street Journal, Researchers at Virginia Tech have developed software for the Android OS that enforce policies on mobile devices based on what room they're in, http://blogs.wsj.com/digits/2011/10/18/tech-today-apple-yahoo-report-earnings-today/?mod=google_news_blog
10. PC Magazine, VT Technology Locks Apps/Smartphones to a Physical Location, http://www.pcmag.com/article2/0,2817,2394719,00.asp#fbid=_HtZdgnRfIV
11. Huffington Post, Jules White's Debut L.A. Exhibition at the Gregory Way Gallery
12. Huffington Post, 21 of the Coolest Book Covers of the Year
13. CBS Smart Planet, Armed with smartphones, 'citizen scientists' to collect disaster data
14. Discovery Channel Planet Green, Smartphones and citizen scientists can help streamline disaster relief
15. Christian Science Monitor, Venture capital firms think small to help startups
16. Motorola MOTODEV Podcast
17. The Tennessean: Venture Capital Firms Think Small to Help Startups
18. Tech News World: Is Dell Getting Its Android On?
19. The Vanderbilt Hustler: Vanderbilt Students Help Launch Hands-on iPhone Course
20. Inside Higher ED: Where Phones in Class Are OK
21. On GWT: Gwigo - Social Mapping Powered by GWT and AppEngine
22. The Vanderbilt View: Application Inspiration
23. Venture Nashville Connections: 'Smart tech ventures spawned by VU students and entrepreneurs

Panels

1. The Story of Leaf Global Fintech, Vanderbilt 2021
2. Big Data + Privacy in the COVID Era, Vanderbilt, 2020
3. Security - Understanding Threat Vectors, Panelist, FOSE 2012, Washington D.C.
4. Model Based Systems Engineering- A solution to complexity or just a complex solution?, Panelist, DACS Webinar
5. Modeling- Is Standardization Hurting or Helping the Field?, Moderator, Models 2006, Genoa, Italy
6. Introducing Model-Driven Development into the Undergraduate Curriculum, Moderator, Models 2006, Genoa Italy

Invited Talks

1. University of Colorado Boulder, Manufacturing Cybersecurity, Boulder, CO, 2019
2. Federal CPS Interagency Working Group on Cyber-physical Systems, Manufacturing Cybersecurity, May, 2019
3. WICAT Keynote at VT-Wireless Symposium, Blacksburg, VA, 2012
4. SPRUCE - A Case Study in Multi-Dimensional Resource Optimization using Program-scale Data, Candidate Solutions, DACS Webinar, March 2011
5. Raytheon ISaCTN Conference, Dallas, TX, April, 2010
6. IEEE Computer Society Monthly Talk at the University of Alabama at Birmingham, "Optimizing the Configuration of Software Product-line Variants," November, 2008
7. Dagstuhl Perspectives Workshop on Model-Driven Engineering of Complex Systems, "Model Intelligence," August, 2008
8. The University of Alabama at Birmingham, "The Generic Eclipse Modeling System," December, 2008
9. Vanderbilt University EECS Departmental Seminar, Nashville, TN, "Feature Model Based Application Healing," December, 2008
10. Lockheed Martin Advanced Technologies Lab, Cherry Hill, NJ, "Continuous Model Integration," November, 2007
11. Siemens AG, Munich, Germany, "Domain-specific Modeling Languages," June, 2007
12. Siemens AG, Munich, Germany, "Model Intelligence," June, 2007
13. Vanderbilt University EECS Departmental Seminar, Nashville, TN, "Automatic Role-based Constraint Solving," December, 2008
14. University of Waterloo, Waterloo, Canada, "Role-based Object Constraints," December, 2006
15. Siemens AG, Munich, Germany, "Automating Automotive Component Deployment," August, 2006
16. Vanderbilt University EECS Departmental Seminar, Nashville, TN, "Simplifying the Development of Product-line Customization Tools via MDD," November, 2005
17. OMG Real-time & Embedded Systems Workshop, Washington D.C., USA, "Simplifying the Development of QoS-aware EJB Applications via Model-Integrated Computing," July, 2005
18. Raytheon, Portsmouth, Rhode Island, "Simplifying the Development of Autonomic EJB Systems with MDD," April, 2005

Selected Software Development Accomplishments

1. Created the wayfinding system for the Dell Seton Medical Center at the University of Texas at Austin
2. Created the wayfinding system for the Vanderbilt University Medical Center
3. Created the wayfinding system for St. Thomas Midtown Hospital

4. Project leader for the Eclipse Foundation's Generic Eclipse Modeling System (GEMS) project,
<http://www.eclipse.org/gmt/gems>.
5. Eclipse Foundation committer.

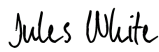
Declaration of Jules White, Ph.D.

U.S. Patent No. 12,353,917

I hereby declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

2/24/2026

Date

Signed by:

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Jules White, Ph.D.